SERVER ROOM CLIMATE & POWER MONITORING

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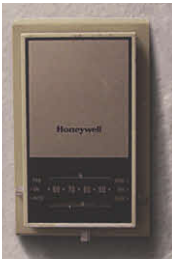
Introduction

The $160,000 Sunday Cook-in

The meltdown at Acuity Software spurred development of low-cost server room monitors - a true story.

The equipment didn't look dead. It looked the same as it did three days ago. No burn marks, no melted faceplates. Even the Cisco logos on the routers were still shiny white. One thing was different: it was very quiet in the server room. Inside, the room normally sounded like a vacuum cleaner, plenty of fan noise.

Not today. All the gear was dead.



Someone set this little guy to 95 F. It did its job, and killed the gear in the process.

Our IT manager was removing some servers from the racks and placing them on wheeled metal cart that looked like the kind the food caterers delivered lunch on. On several units, the tiny lights were fixed on, as if the electronics inside the pizza-box cases were still alive, begging to be freed. No rapid, urgent flicker, as in the past. Just steady pleading from inside of some of the units. Our server room was toast. "All the gear is dead?" I asked.

"Fried. Somebody left the thermostat turned up over the weekend and the heater cooked the gear."

"The heater blows into the server room?" I asked.

"Yes, it blows right in there." He pointed to the ceiling register.

"Any chance you'll be able to save the disks?"

"Very little. The heat sublimates the bearing oil. The drives go dry and seize up. I'm sending them to a recovery shop, just in case," he said half-heartedly.

I called an IT friend at another company and told him what happened.

"The heat adds up; you have the heat from all the gear, plus the heat dumping in from the ceiling grill," he answered. "I'll bet it was over 110 degrees in less than six hours. Inside the equipment cases it was over 130 degrees. Your gear is scrap, not worth repairing." He gave me no hope.

He asked what kind of software was on the equipment.

"Our internal web and data servers. E-mail, the CRM stuff, and the development guys files," I answered. "Everything except the corporate web site." The corporate web site was hosted in New Jersey.

"Tough deal there," he counseled. "Replacing the hardware will take a week or more. Installing the software could take a month."

"What if we have back-up disks?" I asked hopefully.

"Unless you have the same gear coming in as you burned up, there will be incompatibility problems. How old was the gear?"

"Maybe five years old." The depth of the problem was expanding. We had bought some of the equipment from the last start-up company occupying the building. We had not installed much of the software ourselves. We probably didn't have all the CDs. Heaven knew where all the license codes lived.

IT gear more than five years old is considered geriatric equipment. Probably no parts were available, and they were certainly long out of warranty. It would be a fresh start on the equipment list.

The Cost of the Meltdown

I asked the lead software developer what was in the room and he gave me a thumbnail list. There were far more machines in the room than I recalled, even though the room had hall windows. I added up his guess at what was lost. Over $100,000, not counting the time needed to re-order the gear. The IT guys had a sizable project.

Cost of Replacement Equipment

Device	*Quantity*	*Cost*	*Total*
Routers	4	$6,000	$24,000 Servers
	8	$10,000	$80,000 Switches
	2	$1,000	$2,000 UPS
	2	$1,000	$2,000
		Total:	**$108,000**

"That's what the equipment replacement is going to cost. You have to reload the application software. You do have the CDs around the shop, right?"

I answered that we must have them somewhere, but I recalled we had a complex-looking magnetic tape backup system in the room with the equipment. I wondered if the back-up unit got fried along with the gear. "The application software is on the back-up tapes?"

"No, and if it is it's probably an old version. Your guys will probably first reload the Exchange Mail Server and then work on the Pivotal CRM system. The developers can load their own stuff back. All the employee data files should be on the back up tapes." I wondered if anyone had ever tried a backup. My PowerPoints were on one of the disks stacked in the hallway. I had two weeks of work in those slides.

Since I didn't know salaries for anyone except myself, I used consultant prices to reinstall the software. I showed my spreadsheet around and most folks thought the cost would be twice that, but come back in two weeks and we'll have a better idea. Nobody felt like talking about the meltdown, much less the IT guys who had become almost invisible.

"Plan on at least a month getting back up unless you have folks trained on those enterprise-size systems in-house. You'll be feeding CDs into those replacement machines for weeks. Just rewriting the router tables will take a couple of days."

Cost of Re-installing Software

Device	***Apps***	***Days to Reinstall***	***Total Cost @$1000/day***
Routers	4	5	$5,000
Servers	30	40	$40,000
Switch	2	5	$5,000
UPS	2	2	$2,000
		Total:	**$52,000**

Nobody ratted on who set the thermostat, but we were all under suspicion.

I asked various technical staffers who had lost some computer capability when the room melted down how much time we lost. Weeks, easily, they said.

I felt bad about the melt-down. I had been there that winter Saturday when one of us had jammed the thermostat setting to the highest setting, 95 degrees. The heaters must have fully kicked in after we left. We froze most of the day, and forgot about the thermostat setting.

The thermostat cost $50. I never got my PowerPoints back. If I ever built a server room, I knew this wasn't going to happen to me.

Comments by Gerry Cullen, who participated in the meltdown. He left Acuity to found NetBotz and, later, ITWatchDogs.

Both are leading providers of server room monitoring equipment.

Chapter 1

Monitoring Techniques

Things That Kill Gear

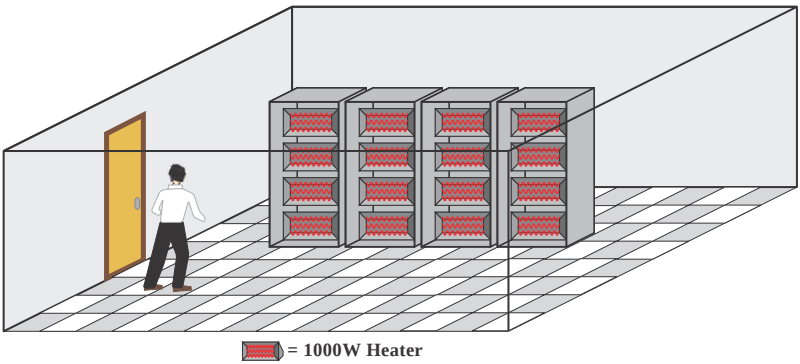
Protecting existing server rooms is difficult because most legacy server rooms are dissimilar and the threats are multiple. One tried-and-true configuration may not work in another server room. This chapter will show a variety of methods to monitor server rooms that have proved effective in many years of instrumenting server rooms.

The five fundamental threats:

- Heat, both inside and outside
- Water
- Fire and smoke
- Power Failure
- Intrusion

Heat Created by Equipment

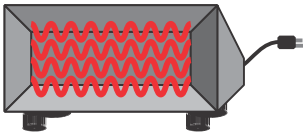
Almost all the electricity consumed by computer equipment is converted to heat. One feature of heat is its desire to quickly distribute itself. With multiple cabinets and dozens of fans, the heat becomes uniform through the room. The room feels hot, but there is no glowing stove to demonstrate the amount of heat entering the room. If you moved around with a hand-held thermometer, you would see hot spots, some more than ten degrees above the average temperature.



Server cabinets full of floor heaters – an illustration to emphasize graphically how much heat is produced in a typical server room.

Imagine the equipment replaced by floor heaters, the kind found under almost any desk in Nebraska. A typical heater produces 500 watts, and can easily take the edge off a cold cubicle.

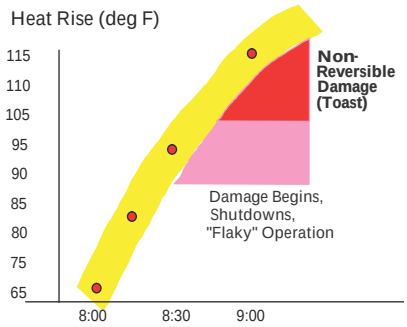
Now imagine each piece of equipment replaced with a floor heater. A typical PC uses about 300 to 400 watts, not including the monitor. For the sake of easy multiplication, let's say your server room has 30 devices, each consuming 500 watts, for a total of 15,000 watts.



A typical server produces about the same heat as a small floor heater

If that number doesn't seem impressive enough, try visualizing 30 floor heaters in the room. Turn all the heaters on and come back in 30 minutes.

How hot would the room be?



Depending on the room's size and insulation, the temperature could rise 10°F in less than 30 minutes. In an hour the room could be over 100°F.

Computer gear converts almost all the electricity into heat. There is no water pumped or logs sawed (work); other than the internal fans and the disk head arms, 90% of the electricity converts to heat.

A heat-gain calculation showed that the internal temperature of the room would increase about 15°F every thirty minutes. The room rapidly becomes an oven. In most legacy server rooms, the air conditioning system has no margin for error; at best, most legacy air conditioners can barely cope with removing the internally generated heat. There is small or no performance margin.

If the air conditioning partially failed, the room will heat up, and the equipment's maximum operating temperature could be exceeded within only a few hours. If the air conditioner fails completely, the room could be in melt-down condition in as little as an hour, ruining the equipment.

Temperature Inside the Equipment Case

At a recent trade show, two Cisco-certified (CCIE) network maintenance technicians commented on the importance of keeping the equipment within operating temperatures. Here are their remarks:

"It's more critical than many IT guys think," said the first technician. "A typical rack-mounted device can run about 20 degrees hotter inside the unit than the outside temperature."

We told them about our meltdown worries.

"Happens a lot. Heat is the big killer. If the gear doesn't fail outright, it gets flaky."

"What's 'flaky'?" we asked.

"Some of the integrated circuits become intermittent because of the over-temperature operation. The silicon junctions in the integrated circuits can't dissipate the heat and they become unreliable, even after the gear cools down. You now have unpredictable equipment."

"For example, a dependable server suddenly becomes unavailable. You can't see the site or read a disk file. Somebody gets mad and starts calling you saying the server's down, so you go racing around looking for server problems. Just as suddenly, the server reappears and the complaints cease. You go nuts. This happens every week. You move stuff to different servers, you drive everyone crazy by pinging the gear every minute. You have flaky gear." He obviously spoke from experience.

The second technician added, "If we have a performance guarantee in our maintenance contract, we can insist on replacing our gear if the room temperature goes above 95°F for more than an hour. Once gear gets flaky, it can drive our costs up and our reputations down."

Removing the Heat

Taking the floor heater example one step further, let's cool the room with a dedicated air conditioner. Note the word *dedicated* – many legacy server rooms use existing the building's existing air conditioning system, which adds more complexity because the heat load in other rooms may change, affecting the air conditioner's performance. A common example of this is when an office copier is added to an office adjacent to the server room. A large copier can produce 1,000 watts of heat when in operation, which the building air conditioner has to remove

15,000 watts of heat needs two tons of air conditioning to remove. (See calculations in Appendix.) To put this into perspective, a two ton air conditioner will cool a three-bedroom home to 72°F in an Arizona summer.

Added to this calculation is the external temperature. Hot walls require air conditioning. A stand-alone building in a Michigan winter has different cooling requirements than a similar building in a Florida summer. To simplify our example, we will assume the outside temperature is 72°F.

Since we only have about an hour before the equipment is damaged, we need to instrument the air conditioner to get the earliest warning. A well-running air conditioner should have a 20°F difference between the air inlet (suction) and the output (discharge) sides of the evaporator coil. If the filter begins to clog or the refrigerant starts to leak out, knowing the difference between these two temperatures may provide a week's notice that there is a problem. Having temperature graphs is important here.

We recommend measuring the temperature in four locations. The first location is at the wall thermostat, so we would know what the thermostat saw as it controlled the compressor and fan. A locked cover for the thermostat is highly recommended; one accidental brush of a cleaning person's vacuum hose is all it takes to turn off the air conditioner.

The next location is the hottest part of the server cabinet – between two "pizza-box" servers is a good start. One IT manager uses a hand-held infrared thermometer to find the hottest locations, then places sensors in those hot spots. The hottest locations will be the first temperatures to rise quickly if the cooling system fails.

The air conditioner should be instrumented in two ways:

First, the inlet temperature should be measured. A common way to do this is to tie-wrap a Remote Temperature Sensor to the air inlet grill in the

In the same manner, attach a sensor to the air-conditioning output grill. The difference between these two readings reflects the efficiency of the unit. Some IT managers, particularly in the southern states, recommend monitoring the outside (ambient) temperature as well, in order to see what the building was subjected to.

Since the air conditioner is vital, experienced IT managers know that an emergency monitoring and repair plan is essential. First, place multiple personnel on the alert list. If somebody is on vacation – and someone is *always* on vacation or sick when alarms come in – the backup personnel will get the alarm.

Every IT manager who has lived through an air conditioning failure agrees that a service contract with a reliable A/C repair company with backup personnel must be established. The repair service must have 24 hour service. One IT manager even goes so far as to keep spare parts for his air-conditioning systems in-house.

Many IT managers recommend monthly reviews of temperature logs downloaded into a spreadsheet for analysis. Many things can happen during weekends and holidays, and the logs will show if the room has undergone a spike in temperature.

Monthly testing of temperature sensors – such as heating them with a hair dryer to deliberately trip the alarm – is also highly recommended.

The logic behind all these recommendations is to get the earliest warning possible. High temperatures in the spaces between the pizza-box servers could indicate a problem; once the air around the wall thermostat or the A/C inlet gets hot, it may already be too late to save your equipment. Remote temperature sensors can have wire runs of hundreds of feet.

One well-placed temperature sensor can deliver an hour's early warning, enough time to get a repair technician on site.

How UPS Helps Cook the Gear

Ironically, a UPS unit can help fry your equipment. While a UPS can keep the server equipment running when main power fails, it doesn't keep the air conditioners going.

While keeping the equipment running during a power failure may make the users happy, it also means that the gear will keep making tons of heat. As we saw before, in as little as one or two hours the equipment could fry itself into scrap.

If main power fails for more than a few minutes, the safest thing for the server room equipment would be to shut each down until the air conditioning is restored. The servers should be gracefully shut down; programs exited, files closed, and the machines powered off. While an hour or two without service may frustrate your users, just imagine how much worse it will be if your system is off-line for days or weeks because you had to re-build the entire server room after the equipment cooks itself!

Hot Spots, Temperature Variations

When the thermostat on the wall reads 72°F, the natural tendency of most people is to assume this means that the room is 72°F everywhere. But of course, this simply isn't the case; temperatures can vary by 10 degrees or more in a room, and variations of 20°F inside server cabinets are common.

One WeatherGoose user attempted to check the accuracy of his remote temperature sensors by arranging them on an eight foot long workbench located against one end of his server room, spaced equally apart across the bench. He discovered, to his surprise, that one end of the work bench was 8 degrees hotter than the other end! At first, the user suspected faulty sensors, but by placing an industrial digital thermometer at each end of the bench, the user verified the temperature difference was real.

To minimize the "workbench effect" he tie-wrapped all six temperature sensors together so that they would all be reading temperatures in the same spot on the bench. Once tied together, all the temperature sensors read within half a degree F of each other.

Another IT manager, who built a 50' x 50' server room (large by our standards, small by data center standards), related her experience:

"We have hot spots in our data center. I can show you a 10' wall section 15°F higher than the rest of the room. I'm putting in an additional air conditioning duct to hit that spot," she commented.

These experiences illustrate the importance of monitoring your server room's temperature with several sensors at multiple locations – otherwise, equipment on one side of the room might be running hot while equipment on the other side is well within normal limits, and you might never know until it's too late.

Backup Air Conditioners

From a peace-of-mind perspective, the most secure method of preventing a meltdown is to have a backup air-conditioning system that is completely separate from the primary system.

Whether a stand-alone portable unit or a duplicate in-ceiling machine, this is a practical way to keep equipment in operation while the primary air conditioner is being repaired.

One user reported he had installed a backup cooling system from a contractor built from used components for $5,000, including installation.

We mentioned this to a local IT manager and she said, "A backup air-conditioning system, which I still don't have, is next on my budget list. By the way, you're right about the UPS helping cook your gear. I hadn't thought about that until you mentioned it."

Water is Everywhere

One IT manager we spoke to mentioned he had survived a fire protection sprinkler accidental turn-on incident. He tells about his experience with water:

"The sprinkler just turned itself on. Don't know why. A software guy walked in right as the sprinkler started spraying down on a line of five server cabinets. A maintenance guy found a big Styrofoam food cooler in a closet and climbed up on a chair to place it directly under the sprinkler head. He wrapped his sweater around the sprinkler head to help catch the water.

"It took ten minutes to figure out how to shut off the sprinkler water. Before they shut it down, three developers emptied the food chest eight times into trash cans. Could have been a disaster.

"We started counting water pipes around the server room. Water pipes were in the ceiling, the walls and under the raised floor.

"A slow flood could take an hour maybe, but the sprinkler eruption would be catastrophic. What we needed was a permanent version of the Styrofoam cooler to catch sprinkler leaks and other overhead leaks.

"The metal tray was simpler to build than we had imagined. A local air conditioning sheet metal shop made two trays with hangar brackets and ½" drains for less than $150. We punched pencil sized holes in the acoustic tile ceiling and hung the catch trays over the cabinets. The drain was a real problem. The maintenance guy for the building helped us route the garden house to a sink drain on the first floor."

Water Sensors

Most water sensors measure the difference between the conductivity of air and the conductivity of water. ITW water sensors have a low voltage applied to four metal brads on a plastic case.

When the water touches the brads, it completes the circuit and the current begins to flow. If the metal brads are touching a surface such as a concrete floor, the graphs will show a decrease from reading 99 (dry, no current flow) to 80 (damp) to 55 (full conductivity).

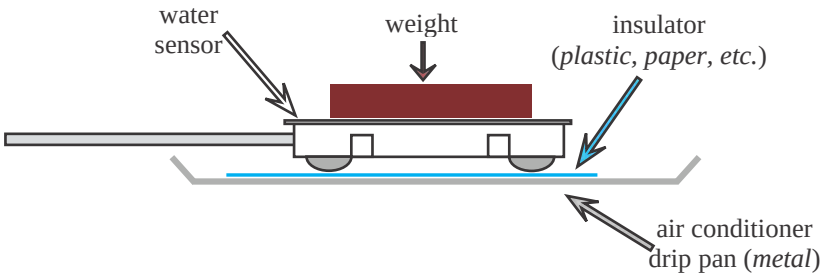
Make sure that the surface the sensor is placed on is nonconductive. Since the sensor detects water by electrical conductivity between the metal brads, if those brads are in contact with a conductive surface – such as a metal tray – the sensor will *always* show full conductivity, wet *or* dry.

Routine testing of water sensors is essential. Unlike temperature, which can show revealing trends over time, water is likely to be an all-or-nothing event. Periodically dunking water sensors in a cup will confirm the sensors are operational.

Correct orientation of the sensors is also essential. We were looking at another installation in a data center. I asked the tour guide to see the water sensors, and he lifted a floor tile to show me a sensor he had installed near a floor drain point. The sensor had been installed upside-down! Be sure the metal sensor brads are against the floor, or the sensor won't work.

Installation rules for water sensors:

1. The sensor must face down – metal brads against the floor.
2. Placement locations:
    a. Water collection trays such as the trays below sprinklers. Don't forget to insulate the sensors with a piece of vinyl floor tile.
    b. Lowest point on the floor or below raised flooring. Find the lowest place on your floor. Spill some water and see where it puddles in your server room. That's a perfect place for a water sensor.
    c. Below a water pipe junction where the chances of a pipe leaking are good.
    d. In back-up air-conditioning condensation trays. If the primary tray's drain clogs up (very common because of algae growth) and the water flows into the back-up tray, once the back-up tray is full the next path for the water may be right onto your server cabinets.
3. Place a small weight or clamp on the sensor so it cannot move. We have seen some sensor installations where the connecting wire had raised the sensor to 3" off the surface. The water would have had to reach 3" in depth before the sensor would signal the alarm! Nylon tie-wraps are another good way to restrain a wandering water sensor that doesn't want to stay where you want it to.
4. Test the sensor. Dunk it in a glass of water and see if you get an alarm. Wipe it off, then place it on a wet napkin and note the reading.
5. Make sure the sensor is installed on an insulated surface. If the sensor must be placed on a metal surface, such as inside an air-conditioner's condensation tray, place something non-conductive, such as a plastic sheet or a vinyl floor tile, underneath the sensor in between the sensor and the galvanized metal, as illustrated below:



Smoke Alarms

Most buildings have existing smoke alarms. The problem is that when they sense smoke there may be no one around to hear it. That problem is solved with an ITW smoke alarm which interfaces directly to the climate monitors.

Many smoke alarms have a third wire that enables one smoke alarm to set off other alarms, such as in a hallway or long building. ITW uses this extra wire to relay the alarm signal to a WeatherGoose as well. The smoke alarm still operates in the normal mode, but now an e-mail alert can be sent to someone offsite in addition to the smoke-alarm's siren.

Power - How to Keep the Juice On

The nightmare of power strips stems from the internal circuit breakers in the power strips. An electrician explained there are two types of circuit breakers in power strips, thermal and magnetic.

In most installations, web or e-mail servers are expected to turn-on and stay running. If the power consumed exceeds the limit of the circuit breaker, the entire computer system will be abruptly disabled. There is no advance warning for breaker tripping; one day all the equipment plugged into the affected power strip goes off. The IT manager is left to wonder if the normal operating load current was exceeded, or if the circuit breaker has become defective.

Suppose a power strip is rated at 15 amps. If the strip uses a thermal breaker, and the total load on the power strip held steady at 16 amps, the thermal breaker would eventually trip and turn the entire strip off.

But if the strip uses a magnetic breaker, and a power surge occurred which briefly raised the current above 15 amps, the faster-acting magnetic circuit breaker would trip even if the normal load of the equipment connected to the strip was considerably less.

Many IT managers set a policy to not exceed 60% of a power strip's rated capacity. A 20-amp power strip, for example would be restricted to having no more than 12 amps' worth of load connected to it in normal operation. The hard part is learning how much current is going into the strip.

An electrician can measure the draw of each power strip by powering down the existing power strip and inserting a break-out box, or by using a

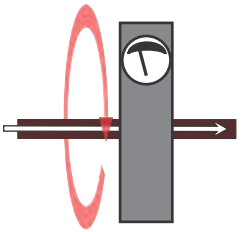
hand-held clamp-on ammeter. But the usefulness of these measurements is usually short-lived, because equipment tends to migrate from cabinet to cabinet and new equipment is always being added. If the breaker trips, a trip to the server room is needed to reset the breakers, and the IT manager has to determine why the breakers tripped. Usually, this is not easy.

There are two ways to monitor current in existing power systems: Current Transformers, and In-line Current Meters

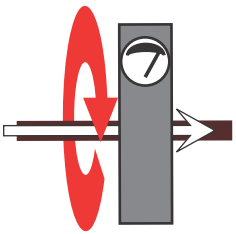
Current Transformers

A current transformer (CT) surrounds a single alternating current-carrying wire and converts the current into a 0 - 5 VDC signal suitable for input to a WeatherGoose analog-sensor jack. The CT supplied by ITW can be selected for 30, 60, or 120 amp scales with a slide switch.

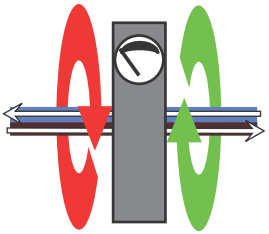
The most common place to mount a CT is around one of the wires entering or leaving the breaker box. It cannot be used around power cords unless a single power conductor is extracted from the cable, or else the opposing magnetic fields will cancel each other out, as illustrated below:



current passing through a single wire generates a magnetic field around the wire, which is detected by the current transformer and turned into a voltage signal



the higher the current being carried by the wire, the stronger the magnetic field, and the greater the voltage signal from the current transformer



opposing currents from the hot and neutral wires generate magnetic fields of opposite polarity which cancel each other out, leaving no field for the

Dual Power Strips

Many devices, such as Cisco routers, have A and B power inputs. If you haven't used equipment with two power inputs, the utility seems vague until you need to power down an entire power strip to add or remove equipment. With dual power-inputs, the equipment automatically operates off of whichever input is "hot", switching between them without interruption. If the equipment you plan to install in your server room is available with this feature, we highly recommend it.

Power Trends Seen in the Graphs

The ability to measure and graph will sometimes show some surprising variations in voltage changes. Normal line voltage in the U.S. is supposed to be 120VAC – and as long as the lights are on and everything is running, it rarely occurs to us that it might be anything else. But when you monitor and graph your power over a period of days, you just might be surprised at what you find.

One customer discovered, after installing his power monitor, that his incoming line voltage sagged at least twice a week to about 100 volts – very close to "brown-out" conditions. Once again, graphs tell the story. The Cisco installer technicians we spoke to said their gear starts shutting down automatically about 105 volts. They recommend running all critical gear off the UPS units, which are far more forgiving of voltage changes and produce a steady voltage output.

We recommend all server room power be on dedicated circuits; that is, the wires should run from the power transformer on the power pole outside the building directly to the computer equipment inside, and the server room should have its own breaker box independent from the rest of the building circuits. Many facility managers oppose this due to the expense, but the benefits can easily outweigh the additional cost.

Door Sensors

These tiny sensors, long used in the security industry, have two parts, a magnet and a magnetically-activated switch. If the magnet gets close enough to the switch, usually within an inch or less, the switch closes. These sensors offer a low-cost option to monitor whether the doors to the server room or equipment cabinets are opened or closed. Server and UPS cabinets are excellent candidates for this kind of monitoring, since under normal conditions no one should be opening those cabinets without the IT administrators' knowledge – not to mention that on some kinds of cabinets, leaving a door open can actually disrupt the proper flow of air across the equipment, decreasing the overall cooling efficiency and making your A/C units work harder. (Or worse, making your equipment run hot!)

Depending on your server room's location and security requirements, you might also place sensors on any doorways allowing access to the room – although this option should be considered carefully; if personnel frequently come and go during the day, the steady stream of alarm mail will quickly become an irritant. However, such alarms can be valuable for weekend monitoring; if a door sensor goes off on a Sunday, when the building is supposedly unoccupied, something is wrong! Fortunately, ITWatchDogs' latest line of monitoring equipment lets you choose whether to receive such alerts all the time, only during business hours, or only outside of business hours, making situations like this much easier to manage.

Note that door sensors will take some carpentry skill and various hand tools to install correctly.

The Well-Monitored Server Room

Whether you have two server rooms to manage, or two hundred, having a proper monitoring system in place greatly increases your chances of surviving a climate failure with minimal damage. Just don't forget to periodically test your sensors!

Appendix: How Fast Will a Server Room Heat Up?

temperature (°C)	*density (kg/m³)*	*specific heat (kJ/(kg°C)*	*specific heat (kJ/(m³°C)*
20	1.205	1.005	1.211
40	1.127	1.005	1.133

Step 1. Calculate Specific Heat: A 3x3x2 meter room is 18 cubic meters, which at 20C gives 18*1.211 kJ/°C = 21.8 kJ/C

Step 2. Inverting to get C/kJ we have 0.0459 °C/kJ 10kW = 10kJ/sec therefore: 10kW dumped into 3x3x2 meter room at 20C will change by (10kJ/sec * 0.0459 °C/kJ), or 0.459 deg Celsius/sec.

This assumes:

1. The room is filled with dry air.
2. The pressure in the room is constant.
3. No heat loss occurs.

The specific heat of water vapor is about twice that of dry air, meaning pure water vapor will change half as much as dry air in the above example. You would have to know the relative weight of water in the air to account for humid air, but the answer will be between 0.25 and 0.45 °C/sec.

Chapter 2

The WeatherGoose II Family

WeatherGoose II Family Overview

ITWatchDogs' family of climate-monitor devices (also known, collectively, as "WeatherGeese") provide remote monitoring of environmental parameters in data centers, server rooms, and in other applications. They watch for extreme temperatures, extreme humidity, failed fans and open doors that should be closed. They can send an alarm if there's water on the floor, or if some other device is drawing too much power or too little. They monitor many other parameters, including light and sound levels. If the room lights are on when they shouldn't be, that might be an indication that an unauthorized person has entered the room. An abrupt drop of the sound level in a room might be due to a fan failure. The sound level drops immediately, while it might take an hour for the temperature to rise significantly.

ITWatchDogs understands that cost is a critical issue for most custom- ers. We work hard to provide the features that are necessary, without adding "bells and whistles" that increase the cost without improving the product. Our climate monitor family has a variety of models and options to fit different requirements, but all of them are based on a standard hardware and software platform that keeps costs low.

The Geese are designed to take up very little spac the largest models are 1U highrack mount llest is only 4 inches long by 1.5 inches wide and deep. T a lot of valuable space in a data-center rack or in a server ost members of the family run off an external 6 VDC power supply (a.k.a. "wall wart"), which is supplied along with the units. Some models also have Power over Ethernet (POE) capability, so they don't require the external supply to operate.

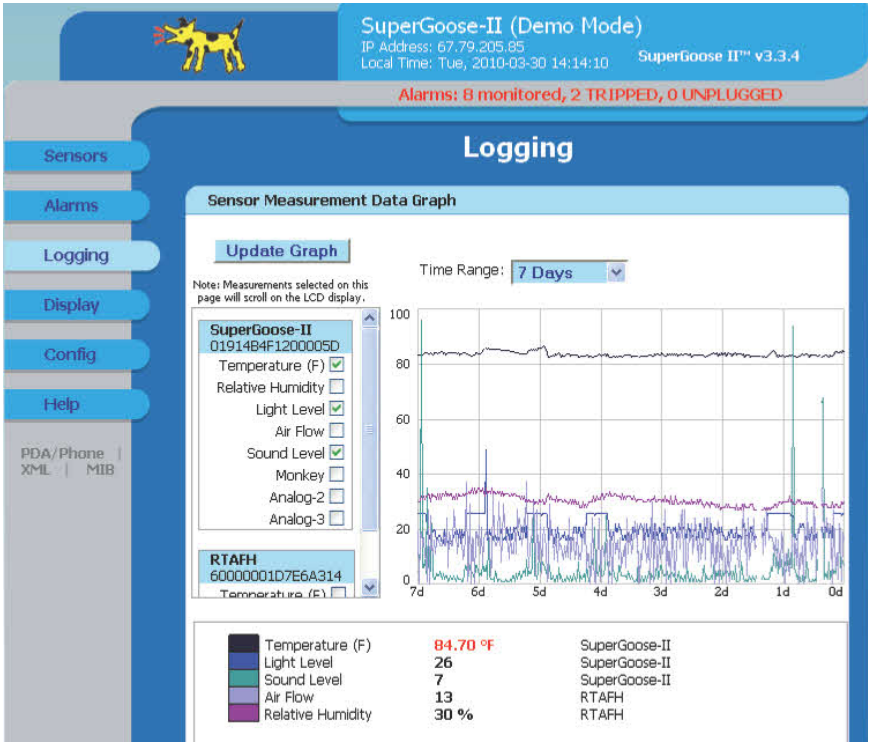
All the Geese have internal sensors; most models allow remote sensors to be connected as well.

ITWatchDogs' climate monitors use standard web server software to display their measurements. No special client software is required, just a regular web browser. Because we use standard protocols like TCP/IP and HTTP, the Geese can be monitored over a local Ethernet network, or they can be connected to the public Internet and monitored from anywhere on

the Net. The monitors have an SNMP "agent" already built-in to the firmware, so they can be accessed using popular network management tools such as HP OpenView, What'sUp Gold, or LoriotPro.

All members of the climate monitor family keep logs of the measurements they make. The user selects internal and external sensors to be logged periodically. The number of sensors selected affects the length of time that the log can cover, but in most cases data can be logged for days or weeks. Data from the log can be downloaded to a PC in "Comma Separated Value" (CSV) format. Most spreadsheet programs (Excel) can read CSV directly, so the data can be analyzed using the spreadsheet's tools. A spreadsheet can also draw detailed graphs of the data, or of any part of it.

The Goose will draw a graph showing any combination of the sensors that you want to see. You can select the time scale, from 15 minutes to one month. The graph is drawn from the data available in the log. The user can determine which sensors are selected to graph, but the data in the log remains unchanged.



A variety of internal and external sensor options are available, including:

- Ÿ Temperature
- Ÿ Humidity
- Ÿ Airflow
- Ÿ Sound Level
- Ÿ Light Level
- Ÿ Water leak detection
- Ÿ Voltage
- Ÿ AC Current
- Ÿ Smoke Alarm
- Ÿ City Power Monitor (monitors the power company voltage)
- Ÿ -48VDC Monitor (for Telecom installations)
- Ÿ Power Consumption, including real power, volt-amperes, and power factor
- Ÿ Contact closures, such as “door open” or “breaker tripped” detectors

Most members of t
family have internal s
measure things
and humidity. The
at least one conne
proprietary technology to connect ITWatchDogs' digital sensors to the Geese. This external bus allows sensors to be hundreds of feet away from the Goose if necessary.

Many WeatherGoose models have general purpose analog inputs. ITWatchDogs offers a set of analog sensors that connect to these ports. The analog inputs can also be used with any type of sensor that outputs a signal between
DC. The analog inputs have weak pull up resistors on them, they can be used to monitor “dry contact” inputs such as external relays or switches.

WeatherGoose II devices can include references to supported IP-enabled cameras on the web page, which causes the browser to display still images from the cameras on the WeatherGoose page. Up to four cameras can be displayed at once. Contact ITWatchDogs for the list of cameras that are currently supported.

Other Applications

ITWatchDogs' climate monitor family was developed to monitor environmental conditions in server rooms, but Geese are used for many other applications. Several schools are using the WeatherGoose II device and some external temperature sensors to monitor and log the temperature in their cafeterias' walk-in refrigerators. If the temperature gets too high the Goose alerts the maintenance people, day or night. These schools are also able to use the temperature logs to document that the temperature has remained within the mandated safe limits for food storage.

A university lab used a Goose in a botany experiment to determine the effect of longer or shorter days on certain plants. The Goose gave them a log of light levels over time, as well as generating an alarm if someone turned the lights on when they were supposed to be off.

Although we don't recommend using the WeatherGoose II family outdoors, one of our customers used a MiniGoose to monitor temperature and humidity in a livestock enclosure, as part of an experiment to see how these quantities affected his animals. (The experiment worked well, but it ended when a spider took the term "web server" a bit too literally and built his web inside the MiniGoose's case, which eventually corroded some of the internal connections.)

At least one telecommunications company in South America has placed several WeatherGoose units in the equipment rooms of remote communications towers to help them make sure the backup batteries are being properly charged and serviced. An emergency-services organization in the northeastern U.S. is using a WeatherGoose to remotely monitor the fuel levels in an LPG storage tank. While the WeatherGoose units may have originally been designed with server rooms and data centers in mind, our customers are always finding new and interesting uses for them!

The ITWatchDogs Climate Monitor Family

The ITWatchDogs Climate Monitor Family includes:

1. WeatherGoose II - the flagship of the family
2. SuperGoose II - Similar to the WeatherGoose II, but with an LCD display and an audible alarm horn included
3. MiniGoose II - WeatherGoose II functionality in a smaller case (4” x 1.5” x 1.5”) with a single digital sensor port.
4. MiniGooseXP II - A MiniGoose with a full array of 16 digital sensor ports and three analog ports
5. MicroGoose - The least expensive member, with only temperature and humidity sensors. The MicroGoose can run off the standard external power supply or off “Power over Ethernet” (POE).
6. RelayGoose II - Similar to the SuperGoose II, but with three low voltage relays to control external devices
7. RelayGoosePOE II - same as the RelayGoose II, but capable of using Power over Ethernet (“PoE”) instead of an external 6 VDC supply.
8. PowerGoose II - The same features as the WeatherGoose II, plus AC power monitoring.

Chapter 3

The WeatherGoose II

WeatherGoose II Overview

The WeatherGoose II is ITWatchDogs' flagship product. Many of the features of the WeatherGoose II are shared by other members of The WeatherGoose II Family. As you can see from the illustration, the WeatherGoose II fits in a 1U high 19" rack mount chassis. All of the connections are on the front panel for easy access.

Input Power

The WeatherGoose II, like most of the family, runs on low voltage DC power. The input voltage must be between 6 and 12 volts. The WeatherGoose II draws about 450 mA at 6 VDC. (It might draw more current if external sensors are connected.) ITWatchDogs includes a suitable wall transformer type external supply with the Goose. This supply can run on any voltage between 100 VAC and 240 VAC, 50 or 60 Hz, so it should be useable in most parts of the world. (International users may need an adaptor to go from the US-style power plug to one that fits their local standard).

Some of ITWatchDogs' monitors can get their power through Power over Ethernet ("PoE"). A PoE capable router supplies power to these monitors using otherwise unused conductors in the Ethernet cable. This eliminates the need for a separate power cable.

ITWatchDogs offers a "PoE Injector" that adds PoE capability when it is not built into the router. We also offer a "PoE Splitter" that works with Climate Monitors that do not have PoE built in. This allows the user to run only the Ethernet cable to the Monitor, instead of both the Ethernet cable and the power cable.

There is one exception to this: the PowerGoose II, described in Chapter 4, has a standard AC power cord rather than the wall transformer.

All members of the family connect to the network using a standard RJ45 jack. The Geese can be connected to any 10baseT, 10/100baseT, or 10/100/1000baseT Ethernet. (Note that the Geese are not compatible with equipment which attempts to force 100-only or 1Gb/10Gb-only operation and does not support fallback to 10Mbit operation. Users of certain Cisco 1Gb/10Gb Gigabit routers, in particular, should beware of this when attempting to connect any of ITWatchDogs' climate monitors into a Gigabit network.)

Reset Button

Underneath the Ethernet jack is a small hole for the IP Reset button, which restores various settings on the unit to their default values. The unit can be reset by inserting a jeweler's screwdriver or a paperclip into this hole. (Note: This is NOT a power-up reset, rather it restores some parameters to their default values. Don't push the button unless you're sure that's what you want)

There are two resets available, "simple" and "total". A simple reset erases the user names and passwords, and resets the network parameters to their default values (see the chapter on WeatherGoose II Firmware for details). To do a simple reset, simply push the button and hold it for 15-20 seconds, until both the "Idle" and "Activity" LEDs light up simultaneously. Release the button and wait about 5 seconds for the unit to finish resetting.

A total reset restores the factory defaults to all settings on the WeatherGoose, including alarms, logging, and display settings, as well as all the Config information. To do a total reset, turn the unit off, then hold the button down while powering up again. Continue to hold the button for at least 5 seconds, then release it and let the unit reboot normally. Again, this erases ALL of your settings, the unit will be as it came from the factory.

Internal Sensors

The WeatherGoose II has five internal sensors

- Temperature
- Relative Humidity
- Airflow
- Light Level
- Sound Level

Temperature can be displayed in Fahrenheit or Celsius, while relative humidity is, of course, displayed in percent. Light level, sound level, and airflow are measured on a relative scale of 0-99, rather than in fixed units of measurement. Ambient light level, for example, displays 0 for dark, to 99 for bright light; airflow readings of <20 indicates still air, while 99 indicates very high airflow; a sound level of 0 indicates quiet, while 99 indicates loud noise. (Note that the "sound level" values are merely an average measurement of the overall sound level in the vicinity of the sensor; the WeatherGoose does not record or transmit the actual sounds picked up by the sensor, and has no provision to do so. The peak/average detector circuit used in the Goose's design does not allow the room sounds to be heard or stored remotely in any way.)

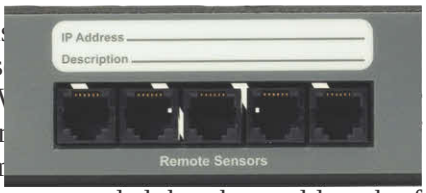
External Sensors

External sensors allow you to measure conditions at several locations instead of just at the Climate Monitor. For instance, a temperature sensor could be placed at an air conditioner duct to measure the temperature of the air coming from it. Things like a dirty filter or a coolant leak can cause that temperature to increase slowly over time, and the graph drawn by a Goose would make such a trend easy to see. Multiple temperature sensors located throughout the room can reveal where the "hot spots" are, so more cooling can be directed to those places.

Using ITWatchDogs' external temperature/airflow/humidity probes to measure the speed of the air entering and leaving a rack can detect when filters are clogged, or airways obstructed, as well as showing trends in temperature or humidity which could help spot refrigerant loss or a decline in the cooling unit's efficiency, in time to do something about it.

Remote Digital Sensors

The WeatherGoose II has five RJ12-style jacks for external digital sensors. These are used to attach external Digital Sensor Bus devices, such as temperature sensors or temperature/airflow/humidity sensors. The Digital Sensor Bus is a proprietary bus developed by ITWatchDogs for us Family. IT- WatchDogs s sensors that use it. The W digital devices, but external splitters ar connections up to the system's maxim the way the Sensor Bus works, it is recommended that the total length of all the sensor cables connected to a single WeatherGoose not exceed 600 feet.



Analog / Dry Contact Input Terminals

This gray 5-terminal block is used to connect non-digital sensors such as current transformers, door switches, or water sensors. Three analog inputs are provided, numbered "**1**", "**2**", and "**3**"; the two terminals labeled "**C**" are the electrical "common", or ground. (Two "**C**" connections are provided for convenience; internally, they are tied together, so it doesn't matter which sensor ground is connected to which terminal.)

The analog inputs can be connected to any analog sensor that puts out a 0~5 VDC signal, as well as with "dry contact" signals such as door switches or relays. ITWatchDogs sells a variety of analog sensors for use with the WeatherGoose, including water sensors, door contacts, voltage and current measurements, and smoke alarms. See the "Analog Sensors" tab at www.itwatchdogs.com for more information.

The input voltage should never be below 0 volts or above 5 volts with respect to the "C" terminals. The Goose measures the input voltages and displays them on a scale of 0-99, where 0 corresponds to 0 volts and 99 to 5 volts. The actual value displayed is an average of several samples to reduce the effect of noise on the measurement. The Goose updates the

displayed values every few seconds. The web page automatically refreshes every 60 seconds, but if you hit the “refresh” button on your browser more often than that you will see the updated values immediately.

The analog inputs have weak “pull ups” on them to supply a small amount of loop current for use with dry contacts, which makes it possible to use them with devices like door sensors or relays. With these types of sensors, a reading near 99 means the contact is open, and a reading near 0 means it’s closed.

The WeatherGoose II is typical of the entire product line. The other members of the family are similar to it; they may have a different mix of features, come in different packages, and/or be intended for different budgets and applications than the WeatherGoose II, but they are all based on the same core design and share a common user interface, making it easy to choose the model that fits your needs for any given installation.

In the next chapter we’ll discuss those other members of the family, concentrating on how they differ from the WeatherGoose II.

Chapter 4

Other Climate Monitors

Other Climate Monitors

The WeatherGoose II Family includes other climate monitors that offer additional features, different form factors, and are intended for different budgets and applications. Other models of the family include (at this writing):

1. The SuperGoose II
2. The MiniGoose II
3. The MiniGooseXP II
4. The MicroGoose
5. The Relay Goose II
6. The RelayGoosePOE II
7. The PowerGoose II

The SuperGoose II

SuperGoose II

The SuperGoose II adds two features to the WeatherGoose II: A 2 line by 8 character LCD display, and an audible alarm horn. The LCD can be configured to display all the available measurements, or just the measurements that have exceeded their alarm thresholds.

Otherwise, the SuperGoose II is similar to the WeatherGoose II. It is the same size, 1U high by 19" wide, and has the same internal temperature, humidity, airflow, light and sound sensors. It has 5 RJ12 jacks for external digital sensors, and three ports for analog sensors or dry contact switches.

Any alarm can be configured to sound the horn when it trips, along with sending emails and SNMP traps as they do on the other members of the ITWatchDogs' climate monitor family. The horn will stop either when the alarm condition is resolved, or when the "*Horn Off*" button on the front panel is pushed.

The MiniGoose II

The MiniGoose II has most of the WeatherGoose II's functionality in a smaller case (4" x 1.5" x 1.5"). It has the same 10baseT Ethernet jack as the rest of the family, and it runs the same firmware. (See the chapter on the WeatherGoose II Family Firmware).

Due to its small size, the MiniGoose II has only one internal temperature sensor, and only a single RJ-12 jack for external Digital Bus sensors, although external splitters are available to expand the single connection into five or sixteen external ports. (The 16-port version is shown below.) The same restriction of 600 total feet (180m) of cable connecting all the digital sensors to the MiniGoose II applies as it does to all the other family members. The MiniGoose II also runs off an external 6 VDC power supply. A suitable wall-transformer supply that runs off 100-240 VAC @ 50/60 Hz is supplied with the unit.

The MiniGoose II does not have any analog/dry contact inputs built in. However, a peripheral called the "CCAT" is available that interfaces analog and dry contact sensors to the digital bus. (See the chapter on Digital Sensors for details)

The MiniGoose Splitter
(16 Port Version)

The MiniGooseXP II

The MiniGooseXP II is an expanded version of the MiniGoose II, designed to fit into a 1U space in a standard 19” rack. Combining the functions of the MiniGoose II and the 16-port splitter into a single unit, it has an internal temperature sensor like the MiniGoose II while providing a full complement of sixteen RJ-12 connectors (the maximum number supported by the unit) for external digital sensors. It also provides three built-in analog-sensor inputs which can support either dry-contact devices (switches, relays, etc.), conductivity sensors (such as water sensors), or sensors which output a 0-5 VDC signal.

Like all members of the WeatherGoose II family, it uses the same firmware, is controlled by the same user interface, and connects to the network via a standard 10BaseT ethernet jack. Since it has both analog and digital sensor connections, it supports the full range of external sensor devices.

The MicroGoose

The MicroGoose is the simplest of ITWatchDogs' Climate Monitor devices. It is designed for applications where temperature and humidity need to be monitored while size, cost, and installation complexity must be minimized.

The MicroGoose has an internal sensor for both temperature and humidity. Unlike other members of the WeatherGoose II family, though, it does not have any provision for adding any external digital or analog connections.

Although it can operate off of the same 6 VDC external power supply as the other Geese, the MicroGoose also has Power-over-Ethernet ("PoE") capability built-in. Some routers and switches support PoE, which uses the Ethernet cable to supply power as well as connectivity to the devices connected to it. This simplifies installation, since a separate power supply and cable are not required – the only cable needed is the Ethernet cable. This makes the MicroGoose especially suited for monitoring areas where an AC power socket isn't available or easily accessible; or for "co-location" data centers where the operators wish to independently monitor conditions throughout the facility, but are prevented by contract or agreement from using any of the power outlets inside the racks being rented by the customers. The MicroGoose is compatible with the IEEE 802.3af Power-over-Ethernet standard.

ITWatchDogs also offers a "PoE Injector" accessory that adds the power connection to a regular Ethernet cable, in case your router does not support PoE. This accessory would be installed near the router, and an Ethernet cable run from it to the MicroGoose.

Again, the MicroGoose can derive the power it needs directly from the Ethernet cable, if the cable is attached to a PoE capable router or splitter. Most other members of the family do not have this capability built in, but a "PoE Splitter" is available that takes the power from the Ethernet cable and generates 6 VDC from it. Using the splitter will allow any of ITWatchDogs' climate monitors (except the PowerGoose II) to run using PoE instead of a wall transformer.

The RelayGoose II

The RelayGoose II adds output and control capability to ITWatchDogs' climate monitors. It includes three dry-contact relays, which can either be energized manually on a web page, or automatically when an alarm trips. Both the normally open (NO) and normally closed (NC) contacts are brought out to the front-panel terminal blocks, so the relays can be wired in whatever way is most suitable for your particular application. The relays can be configured to de-energize when the alarm condition clears, or to stay energized until they are manually cleared from the unit's web page by the user. (This function can be password-protected, so that only users with the *control* or *admin* password can clear a latched relay.) Each relay can switch a maximum load of 30 watts @ 60 VDC or 30 VAC(rms), which is generally sufficient to operate warning lights, alarm sirens, phone dialers, and similar devices.

The RelayGoose II has an internal temperature sensor, as well as 4 RJ12 jacks for external digital sensors and 6 analog/dry contact inputs. It also has an LCD display and an audible alarm horn identical to the ones included on the SuperGoose II.

The RelayGoose II takes up 1U of space in a 19" rack. It is powered by 6 VDC from an external wall-mounted supply. The RelayGoose uses ITWatchDogs' standard firmware (see the Chapter on Firmware), and uses the same sensors as the rest of the WeatherGoose family.

An optional version of the RelayGoose II is available that can run using Power over Ethernet, just as the MicroGoose can. This version is called the RelayGoosePOE II, and sells for slightly more than the standard RelayGoose.

The PowerGoose II

The PowerGoose II

The PowerGoose II combines the climate monitoring functions of the WeatherGoose II, along with a 10-outlet power strip. The PowerGoose II measures the same environmental parameters as the standard WeatherGoose II unit, while also measuring the line voltage and current draw on the power-strip sockets.

The PowerGoose II has the same internal sensors as the WeatherGoose: temperature, humidity, airflow, and sound and light levels. It has four RJ12 connectors for the external digital bus along with three analog/dry contact inputs. It communicates with the outside world through 10baseT Ethernet, and uses the same firmware as all other IT-WatchDogs' climate monitors.

The PowerGoose II includes a 10-outlet, 120 VAC power strip, with the outlets on the back of the unit as shown above. The unit is available in two versions: a 15-amp model, equipped with standard US-style NEMA 5-15P power plug and 5-15R sockets; and a 20-amp model with a NEMA 5-20P power plug and 5-20R sockets. (The 5-20R sockets are of the "combo" type, which can accept either 5-15P or 5-20P plugs.) Besides displaying the environmental parameters, this unit measures the true RMS voltage on the power strip as well as the peak voltage. It also displays the current draw and peak current, as well as the real power being supplied, the power factor, and the product of the voltage times the current (the "apparent power").

A "Remote Display" unit, which connects to the PowerGoose II by means of a coiled telephone-style cord, is available as an optional add-on. This unit adds an LCD status display and an audible alarm horn, similar to those built in to the SuperGoose II and RelayGoose II.

Climate Monitor Comparisons

	MicroGoose	MiniGoose II	MiniGoose XP II	WeatherGoose II	SuperGoose II	RelayGoose II	RelayGoose POE II	PowerGoose II
Internal Sensors								
Temperature								
Humidity								
Air Flow								
Light								
Sound								
Power								
External Sensors								
Digital Ports	0	1	16	5	5	4	4	4
Max Digital Sensors	0	16	16	16	16	16	16	16
0-5V DC Analog Inputs	0	0	3	3	3	6	6	3
Features								
19” 1U Rack Mount								
PoE								
Audible Alarm								†
LCD Display								†
Output Relays						3	3	
110/208 VAC Outlets								10

† *available via optional “Remote Display” add-on*

Chapter 5

Sensors

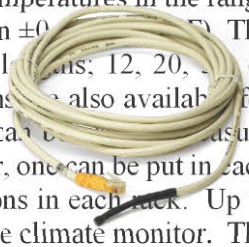
ITWatchDogs has a full line of external sensors that can be connected to most of the climate monitors. There are two classes of sensors: digital and analog. The digital sensors connect to the external digital bus connectors available on most of the climate monitors. Up to 16 digital sensors can be connected at one time - splitters are available for monitors that have fewer than 16 of the RJ12 Digital Sensor Bus connectors. (Note: this bus is a proprietary ITWatchDogs design, and is not compatible with any sensors from other companies.) It allows digital sensors to be connected to climate monitors hundreds of feet away from the sensors. The total length of all the digital sensor cables attached to one climate monitor cannot exceed 600 feet (180 meters). For example, one sensor can be attached to a monitor with 600 feet of cable; or, two sensors with 300 foot cables can be attached to the same monitor, or four sensors with 150 foot cables, etc.

Digital remote sensors available from ITWatchDogs include temperature-only sensors, and temperature/humidity/airflow probes. ITWatchDogs also offers an accessory (the "CCAT") that can adapt analog sensors to the digital bus for climate monitors which lack analog connections, or for those users who need to add more analog sensors than their particular model of climate monitor provides for.

Many of ITWatchDogs' climate monitors have connectors for analog sensors. ITWatchDogs offers analog sensors that can detect water on the floor, alert you when a cabinet door is opened, detect AC line-power failures, and measure AC current draw, to list a few. Any device whose output voltage is between 0 and 5 volts DC can be connected to these analog inputs. Readings from analog sensors are not displayed in any standard units; rather the displayed value is shown as "00" - "99" where "00" corresponds to a 0 V input, and "99" corresponds to a 5 V input. In addition, the analog input ports have weak pull-up resistors on them, so they can also be used to monitor dry-contact signals, such as switches or relay contacts. If the contact is open, the input will read at or close to "99"; while if the contact is closed, it will read at or close to "00". Note that unlike Digital Bus sensors, analog sensors have no inherent wiring-length limit, although excessively long wiring runs could affect the accuracy of the readings due to increased electrical resistance or induced EM interference.

Digital Sensors

Remote Temperature Sensor



The digital remote temperature sensor measures temperatures in the range -40 ~ +85°C (-40 ~ 185°F). It is accurate to within ±0 F). The sensor is available in a variety of cable l ns; 12, 20, or 100-foot lengths are stan- dard, and custom lengths also availab for special applications if necessary. These sensors ca asure the temperature at various places around a room; or, one can be put in each of several racks to monitor the individual conditions in each rack. Up to 16 temperature sensors can be connected to a single climate monitor. The sum of the lengths of all the cables attached to a single monitor cannot exceed 600 feet.

Remote Temperature, Airflow and Humidity Probe

This device combines three sensors – temperature, airflow and humidity – all in one package. Because all of these sensors are combined into a single device, this "combo" probe only counts as one device against the maximum of 16 sensor devices allowed on the digital bus.

The temperature sensor measures from -40 ~ +85°C (-40 ~ 185°F). The airflow sensor reads on a relative scale similar to that used by the WeatherGoose II's internal airflow sensor, from <20 (still air) to 99 (rushing air). The humidity sensor measures relative humidity (0 - 100%) to within ±3%RH accuracy. In addition, the probe will also report a mathematically-calculated "dew point" (the temperature at which humidity will begin condensing out of the air onto any exposed surfaces) using the current temperature and humidity readings.

"CCAT" Analog to Digital Adaptor

The "CCAT" was developed to allow analog sensors to be connected to the digital ports on ITWatchDogs' climate monitors. The CCAT converts an analog signal to a format that can be transmitted over the standard digital bus. It allows more analog sensors to be connected than there are analog ports on a given monitor. Some climate monitors have no analog inputs, but analog sensors can be connected to them using CCATs. Splitters can be used to connect more CCATs if necessary. Since the Goose firmware sees the CCAT as a digital sensor, the total number of CCATs and other digital sensors connected to a single Goose must be 16 or less. Likewise the length of the connecting cable must be included when calculating the total length of all digital cables used, which as has been noted before, cannot exceed 600 feet (183 meters). (Note that the wiring between the CCAT and the analog sensor does not count as part of the 600 ft. limit; only the digital connection from CCAT to climate monitor counts.)

If an analog sensor must be tens or hundreds of feet from a climate monitor, a CCAT can be used to digitize the reading near the sensor instead of at the monitor. This arrangement will reduce the noise on the measurement that may encountered in an electrically noisy room, since the digital bus is much more noise resistant than an analog connection.

Each CCAT is designed to work with a specific analog sensor. ITWatchDogs offers CCAT versions that work with the water detector, smoke detector, City Power Monitor and others. (see the Analog Sensor section starting on the next page). Each version identifies itself to the climate monitor it's connected to, so the correct device name will show up on the web pages. There are also two models of "generic" CCAT available, for use with 3rd-party sensors or specialized equipment which don't have a matching CCAT model (examples of this would include weight transducers, relay contacts from generator or UPS status panels, gas detectors, etc.); a "generic digital" model intended for use with dry contact switches and which displays "open" or "closed" on the web page, and a "generic analog" model which displays a 0-5 VDC input as a reading from "00" - "99", just like the WeatherGoose's internal analog inputs.

CCAT's come standard with either a 12 ft (3.7 M) or 25 ft (7.6 M) cable.

Analog Sensors

ITWatchDogs supplies a full line of analog sensors to go with the WeatherGoose II family climate monitors. These can either be connected directly into the analog inputs of the climate monitors that have them, or to CCATs which convert the outputs to digital format. The exact number of built-in analog inputs, and the style of connector used, varies between models (although most models of the WeatherGoose II family provide three such inputs); more details can be found in the previous section on the various climate-monitor models.

The analog sensor line includes:

1. A water-leak monitor
2. A door-contact switch to determine if a door is open or closed
3. A sensor that detects incoming-power blackouts ("City Power Monitor")
4. A smoke alarm
5. A current transformer, to measure AC current
6. A sensor that monitors positive-ground, -48 VDC voltage levels (for telecom applications)
7. A more sophisticated water leak detector, ("Water Snake") that watches for leaks anywhere along a cable, allowing an large area to be monitored instead of just a single point.

Water Sensor

The water sensor, like all the other sensors, is designed to be connected to one of the analog input ports on a climate monitor. The water sensor has four metal brads on the bottom. It works by measuring the resistance between the brads. If the surface it's sitting on is dry, the resistance will be high, and the sensor will read 99. If the sensor is in a pool of water, the resistance will be low, and it will read around 50 or lower. Readings between 99 and 50 indicate increasing dampness under the sensor.

The water sensor must never be placed on a metal or otherwise conductive floor or it will give inaccurate readings. Several water sensors can be placed around a room and connected in parallel (to the same numbered terminal). If this is done the climate monitor will raise an alarm when any one of the sensors detects water.

The water sensor should be connected to the climate monitor by 22 or

Door Contact Monitor

The door contact monitor uses a magnetic switch to determine if a door is open or closed. The switch body is mounted on the door jamb or some other fixed location. The magnet is mounted on the door in such a way that it is within one inch (2.5 cm) of the switch body when the door is closed. The switch is wired normally closed (the switch is closed when the door is closed). The Door Contact Monitor is usually connected using 24 AWG wire. Runs up to 100 feet (30 M) are common.

City Power Monitor

Most server rooms have uninterruptible power supplys (UPS) to keep the equipment running in the event of a power failure. The problem is that the UPS can only keep the equipment up until its battery is discharged.

When that happens the equipment in the room goes down without any warning. The City Power Monitor provides a way to detect such a power failure. The CPM is plugged in to a wall receptacle that is not behind the UPS. The CPM triggers an alarm as soon as power fails, thus giving the administrator time to bring the equipment down in an orderly fashion.

The CPM is connected to an analog input or a CCAT. If the power is on, the CPM output is approximately 4.5 VDC. When power fails the output drops to 0. There is a 1-second delay between when the power fails and the CPM output drops, to avoid alarming on momentary glitches. When power returns the CPM will wait until it has been back for at least 30 seconds before the output signal returns to 4.5 V. This delay is to make sure that the Goose notices the failure, since the Goose only checks each sensor about every 5 seconds, or less if there are a lot of sensors attached to it.

Smoke Alarm

ITWatchDogs offers a smoke alarm kit that connects a standard smoke alarm to an analog input port on one of the climate monitors. This allows the smoke alarm to operate normally while adding the ability to monitor the alarm remotely. The standard alarm sounds a buzzer and flashes a light when smoke is detected. It runs off a standard 120 VAC power and includes a 9V battery for backup.

The standard alarm includes an output that can be used to trigger a group of alarms when any one of them detects smoke. ITWatchDogs' kit uses this output to generate another output suitable to being connected to a climate monitor's analog input, or to the appropriate CCAT model. When no smoke has been detected the displayed value will be 99; once smoke is detected the value changes to 1. The monitor can be configured to send emails, pages or SNMP TRAPs if that occurs.

Current Transformer

Current transformers clamp around a single AC conductor and output a 0 to 5V value proportional to the current flowing in the conductor. The current transformer can be set to measure 30, 60, or 120 Amps full scale. The output is suitable to be connected to an analog input port on the climate monitors that have them, or to the appropriate CCAT. The output is linear over the range. For instance, assuming the transformer is set to measure 0 - 30 amps:if the current is 0 amps the output will be 0 volts. If the current is 15 amps the output will be 2.5 volts, and if 30 amps are flowing the output will be 5 volts.

The current transformer is we use is a "split core" type, so it can be clamped around an existing wire instead of requiring that the wire be cut and passed through the core.

Important Notes: The conductors in an AC cord **must** be separated – the current transformer must clamp around **one** of the conductors, else the currents in both conductors will cancel each other out. A current transformer can only measure **alternating current** ("AC"). It will not work with direct current ("DC").

-48 VDC Sensor

The -48 VDC sensor is designed to monitor battery voltages in telecom rooms, and for other applications that need to monitor negative voltages. Such systems are also called "positive ground" systems. The sensor measures DC voltages in the range -15 to -60 volts, and converts them into voltages between 0 and +5 VDC that can be connected to an input port on a climate monitor or the appropriate CCAT. By setting appropriate trip points on the monitor's alarm page, the user can be notified if the battery is overcharged or discharged in time to take the appropriate action. The -48 VDC sensor is accurate to within +/-5%, and draws less than 20 mA from the battery.

WaterSnake

The WaterSnake uses a water-sensing cable that ... water anywhere along its length. It is usually run all the wa... around a roo... at the base of the walls. That way water on the floor any... ...re in th... m from any source will be detect- ed. Standard cable l... ...ft, 50 ft and 100 ft; custom lengths are available up to 300 ft long.

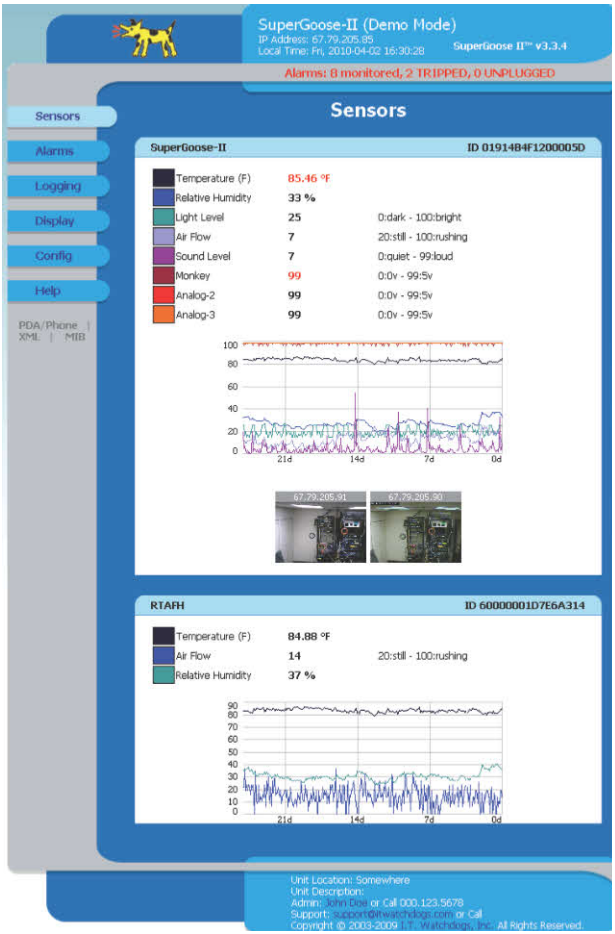
The WaterSnake's control box (not shown) has two relays that are suitable to be connected to the analog inputs of a climate monitor, or to an appropriate CCAT. One relay opens when water has been detected; the other relay opens when the cable has been cut or otherwise damaged. The climate monitor will display 0 when the relays are closed, and 99 when they are open. The user can configure the monitor to send emails, pages, or SNMP traps when either relay opens.

future expansion...

ITWatchDogs is always looking out for potential new applications and sensors to add to our product line, so be sure to visit out web site to see the latest developments.

Chapter 6

Climate Monitor Family Firmware



Climate Monitor Family Firmware

ITWatchDogs' family of climate monitors, which includes the SuperGoose II, WeatherGoose II, MicroGoose, RelayGoose and others (collectively called the "Geese") allow the user to monitor remotely critical environmental parameters in server rooms and similar places, and to be notified when those parameters exceed specified thresholds. The Goose family firmware is designed to take full advantage of the capabilities of the various family members while presenting a human interface that is easy to understand and use. Functionality is important, but ease of use is critical. As with any other device, a climate monitor is not much use if it is too hard to set up and operate.

Note: This chapter describes the Goose firmware as it existed when this book was written. However, ITWatchDogs is constantly adding features and improving the user interface in response to our customers' feedback. By the time you read this book, there may be several differences between the interface and behavior shown here in these pages and the actual behavior of the units being shipped. This chapter should be treated primarily as an overview and general introduction to the WeatherGoose climate-monitoring system, rather than a model- or version-specific user manual.

Users should also check our web site at www.itwatchdogs.com periodically to see if a new release is available; if so, you can download the new firmware release to your PC, then install it into the unit. Firmware updates can be done straight from the unit's configuration web page via your PC's web browser, without any need for a separate update or installation program, and the process uses ITWatchDogs' patented technology to insure that the Goose's program memory will not be corrupted if an upload fails for any reason. If a failure occurs during uploading of the new firmware, the Goose will simply discard the failed upload and keep running using the old version of the firmware.

The same firmware package runs on all the Geese. At power-up, it automatically recognizes which model of Goose it's running on and configures itself accordingly. It identifies which internal and external sensors are connected and initializes them, and displays the appropriate web pages and controls.

The standard human interface to a Goose is through a set of web pages. The firmware includes a fully functional web server. The Geese use standard Internet protocols such as TCP/IP, HTTP, HTTPS, DNS and DHCP, so they are compatible with internal networks or the public Internet. A user does not need any special client software on his or her computer, just a standard web browser such as Internet Explorer or Firefox. ITWatchDogs tests each new release to make sure the web pages are rendered properly by a wide range of browsers.

The Goose-family firmware also includes an SNMP "agent", which means any Goose can be monitored by popular network management packages such as HP OpenView, WhatsUp Gold, or LoriotPro. SNMP v1, v2c, and the secure SNMP v3 are all supported. A Goose can send alert emails through SMTP or ESMTP, and can send encrypted emails via TLS/SSL. ITWatchDogs also offers a Windows application called "Watchdog Console" which allows multiple Geese to be monitored from one PC.

When the firmware starts up it automatically discovers the sensors that are attached and starts scanning them. If a new sensor is attached while the firmware is running, it will be discovered and added to the scan. A new scan is launched about every five seconds or so and the web pages updated. However, the new data will not appear on-screen immediately, unless the browser's "refresh" button is clicked right away. The Goose refreshes the web pages every 60 seconds, whether the user clicks "refresh" or not.

The measurements are stored in a log file, in non-volatile memory. The user can select certain sensors to be logged, or to have all of them logged. Log entries are made every 60 seconds. The amount of data that can be stored depends on the number of sensors being logged, but many configurations have room for 30 days' worth or more. Once the log memory is full, the oldest entries are pushed out to make room for the newest ones, so the log always contains the most recent samples. The data stays in the log until the user explicitly clears it. The user can download the logged data directly from the unit's web page, as a Comma Separated Value ("CSV")-formatted text file. Most popular spreadsheet programs, such as Microsoft's Excel or OpenOffice Calc, can read CSV files.

The Goose can draw a graph of the data from selected sensors over a selectable time scale. The graph is drawn from the data in the log, so data from a given sensor must be being logged in order to be graphed. The user can select data from any combination of sensors to be graphed. New sensors can be selected, and the graph redrawn, at any time. The graphing

function does not affect the data in the log – data from a given sensor stays in the log whether or not it is selected to be graphed.

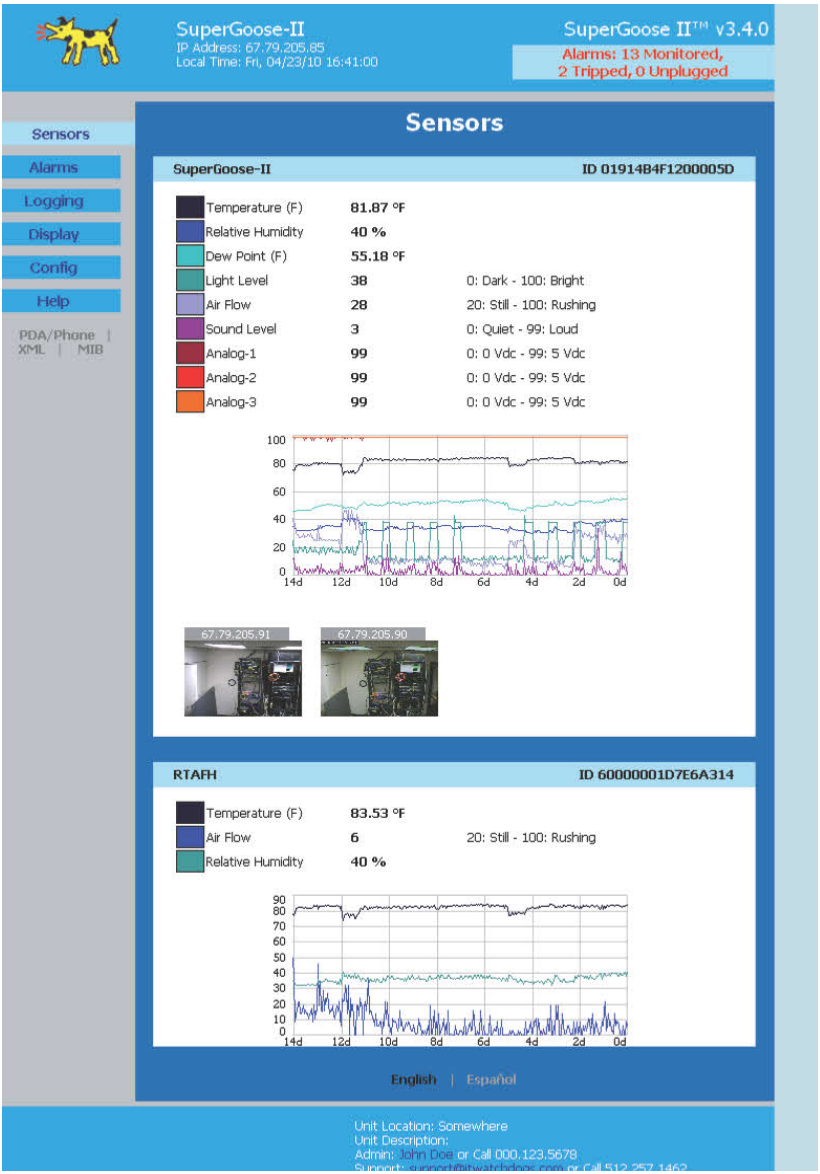
The user can set an alarm threshold on any sensor. If the reading exceeds the threshold, the alarm will be tripped. The alarm can cause an email to be sent to any or all of five specified email addresses, and an SNMP trap can be generated to either or both of two different SNMP managers. Some Goose models also have audible alarms that can be sounded, or relays that can be energized or de-energized, when an alarm occurs.

Multiple alarms can be set on any sensor. Alarms can be set when a measured value goes either above or below a threshold value. A "high trip" combined with a "low trip" will generate an alarm if the value is out of the acceptable range. Multiple "high trips" can be used to implement an escalation procedure if conditions continue to deteriorate beyond the initial alarm. (An example of this would be to send merely a warning e-mail to the facilities manager if the temperature in the room reaches 80 degrees, but to use the RelayGoose II's control capabilities to begin shutting down equipment, or to cause an autodialer to begin calling a list of emergency contacts, if the room reaches 90 degrees.) Most of our climate monitors allow up to 200 separate alarm events to be programmed.

Another feature of the firmware adds images from up to four IP-enabled cameras to a web page. The Goose does not actually read the image from the camera and include it in the page it sends to the browser. Rather, the HTML code for the web page includes a URL which points the browser to the cameras, which causes the browser to fetch the images directly from the cameras themselves.

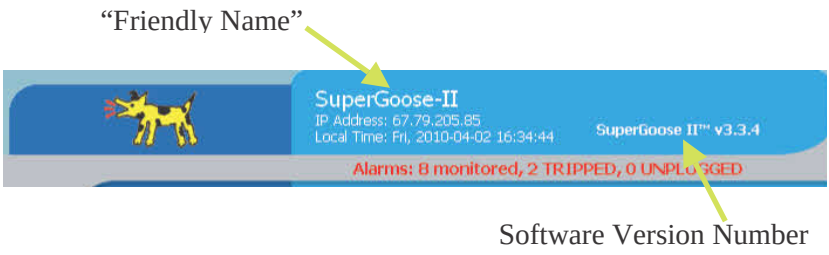
The standard human interface for any member of the Goose family is through a web browser. ITWatchDogs' standard firmware has a built-in web server, so no special software is needed on a PC (or a Mac or a PDA or cell phone) to use any member of the family. ITWatchDogs tests new releases of the firmware with Internet Explorer, Firefox and other popular web browsers to make sure they display the pages properly. Special pages with text-only displays are also provided for use with PDAs or cell phones.

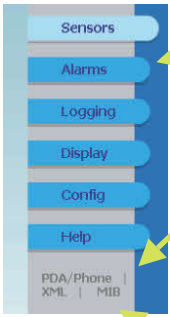
All members of the climate monitor family share a common set of web pages. The screen shots in this chapter are typical examples of pages from any of them.



A typical example of the initial web page generated by a SuperGoose II displaying a status summary, internal sensors, and an external sensor.

The top of each page is always the same. A "friendly name" is assigned to each device by the user, and that name is displayed at the top of the page. The device's IP address is given, as well as the local date and time and the software revision number.





A set of tabs appear on the left side of each page. These are links to the other pages.

The "PDA/Phone" button below the tabs changes the display to a sparse view of the first page ("Sensors"). This allows a user to check on the current readings from all the sensors using a device with a small screen and perhaps a slow data link.

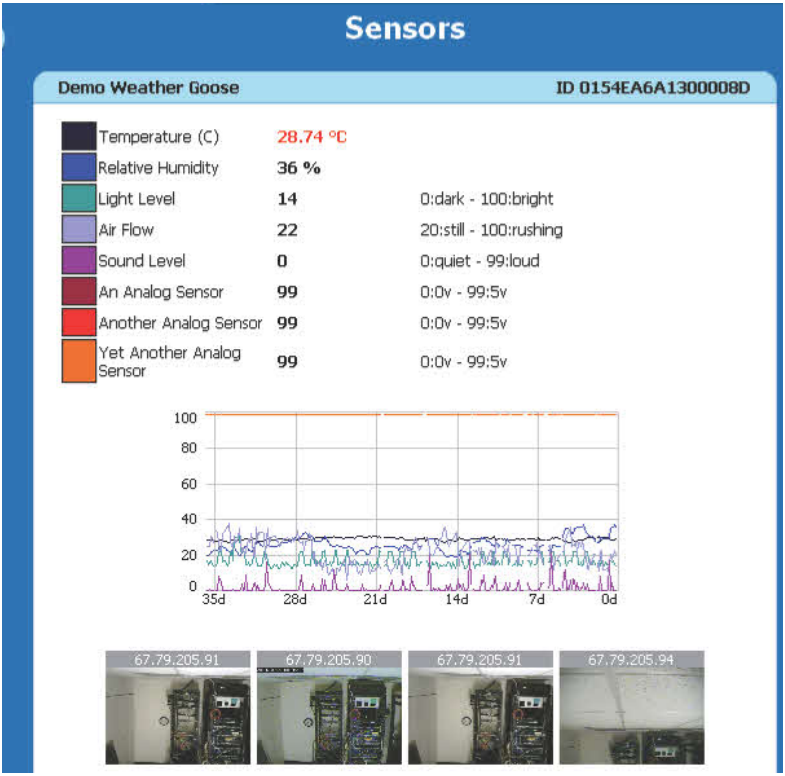
The "MIB" button downloads the information that a SNMP ("Simple Network Management Protocol) Manager needs in order to monitor this device.

The "XML" button allows downloading the current readings in XML (eXtensible Markup Language) format. Certain useful management programs can read data in this format.

Each page has a footer that shows information about this particular Goose so the user can keep track of multiple Geese in a system. These values are set on the Config->Admin page which is described later.

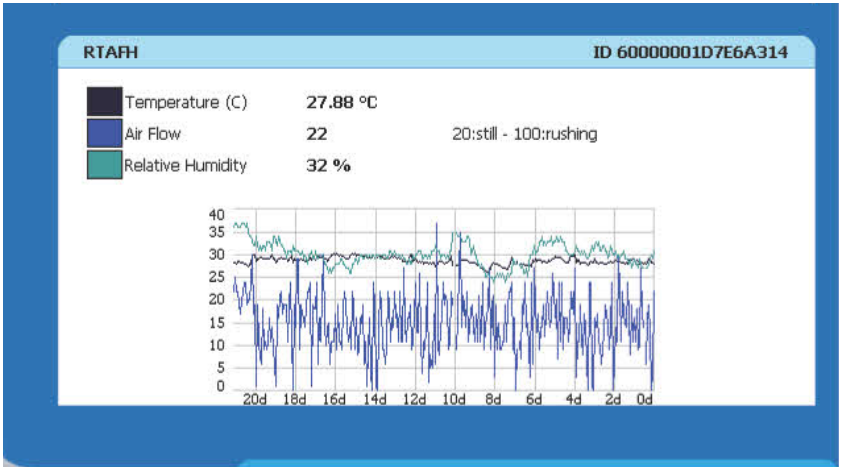
Sensors Page

When the user enters the address of a WeatherGoose II family member into his browser, the first page displayed is the “Sensors” page.



The first part of the sensors page shows the readings from all of the internal sensors, as well as a graph of all the available data. This graph cannot be reconfigured; it always shows all the internal sensor readings since the last time the log was cleared. The screen shot above is from a Goose whose log was cleared about 35 days ago. Since this example is taken from a WeatherGoose II, there are internal temperature, humidity, light and sound levels and airflow sensors. The temperature can be displayed in Fahrenheit or Celsius. Relative humidity is displayed as a percentage. The airflow rate as well as light and sound levels are given as relative values from 0-100.

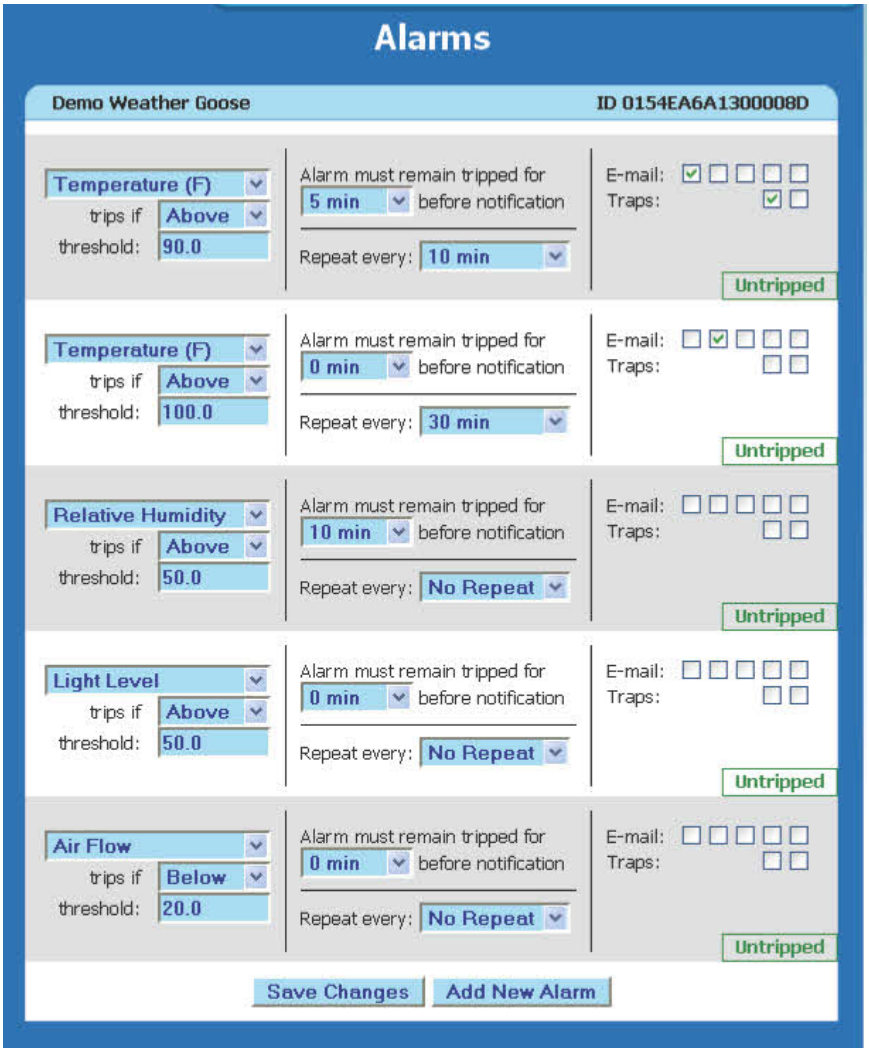
If external digital sensors are connected to the Goose, additional frames appear below the internal sensors frame. In this example, an ITWatchDogs Remote Temperature/Humidity/Airflow sensor probe has been attached to the WeatherGoose.



When additional external sensors are attached, each one gets its own frame. At this writing, up to 16 external digital sensors can be attached to one climate monitor.

Alarms Page

Alarm thresholds are set on the alarms tab. Alarms can be set on any sensor. An alarm can be set to trip if the value goes above a specified threshold or below it. It can be set to trip immediately or after some specified delay. It can also be set to repeat the if alarm hasn't been cleared



after a certain time. When an alarm is tripped, it can send an email to any combination of up to five addresses. It can also send an SNMP trap to one or both of two SNMP managers. More than one alarm can be set on any sensor. The example above shows two alarms set on the temperature reading. The first alarm trips if the temperature goes above 90°F and stays

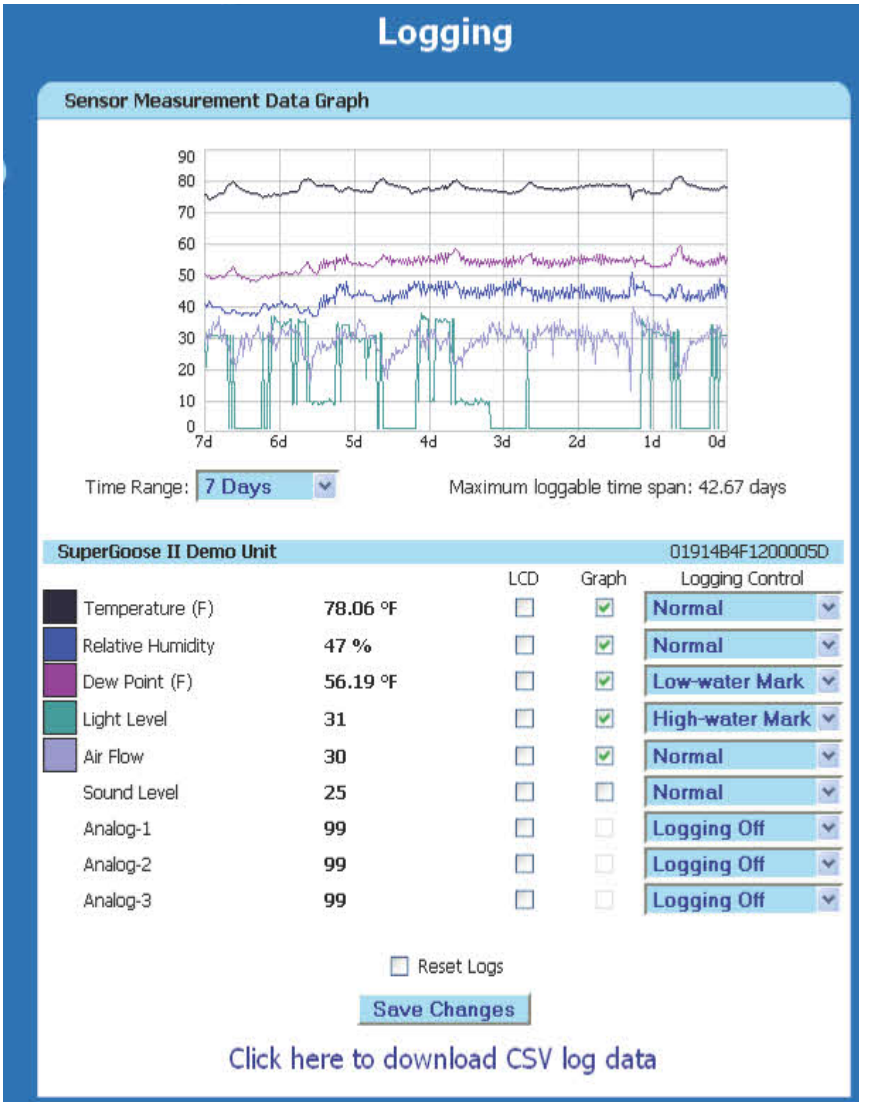
there for at least five minutes. After that time, an email is sent to the first address on the list, and an SNMP trap is sent to the first manager. If the alarm is not cleared after 10 minutes, another email and another trap will be sent.

The second alarm will trip immediately if the temperature climbs above 100°F. It sends an email to a different address. This is an example of an escalation procedure: if the temperature exceeds 90°F the first alarm is tripped, the Goose emails the first responder. If he fails to respond and the problem gets even worse, the Goose will notify another person. Emails can be sent to any combination of five different addresses.

Additional alarms can be added by clicking the “Add New Alarm” button at the bottom of the page. As mentioned before, multiple alarms can be set on the same sensor. Up to 200 alarm events can be set at any given time.

Data Logging

This page allows the user to control the data log, and to configure a detailed graph of the logged data. The log can be configured to store data from any or all of the sensors. The data is logged in a "first-in first-out" manner, which is to say that once the log is full the oldest data is replaced by the newest data. The length of time covered by the log depends on how many sensors are chosen to be logged. The Goose calculates how long that time is, based on the number of sensors and measurements to be logged vs. the amount of memory available, and displays it on the page.



The user can select exactly what measurements are logged. The Goose hardware reads all the sensors approximately once every 5 seconds. Log entries, however, are made approximately every 60 seconds. In "normal" mode, the value logged is the most recent reading. This is appropriate if the input value does not change quickly, for instance the temperature in a room cannot change very much in only 60 seconds. For measurements that can change quickly the user can select the "high water" or "low water" mark. In this mode the value logged is the highest (or lowest) value that was seen in the last 60 seconds. This useful for things like door contact sensors, since a door can be opened and then closed in a short time.

The entire log can be downloaded at any time in "Comma Separated Value" (CSV) format, which can be read by Excel and most other spreadsheet programs.

The user can clear all the data out of the log by checking the "Reset Logs" box. Note that the user must press the "Save Changes" button before any change, including clearing the data, will take effect.

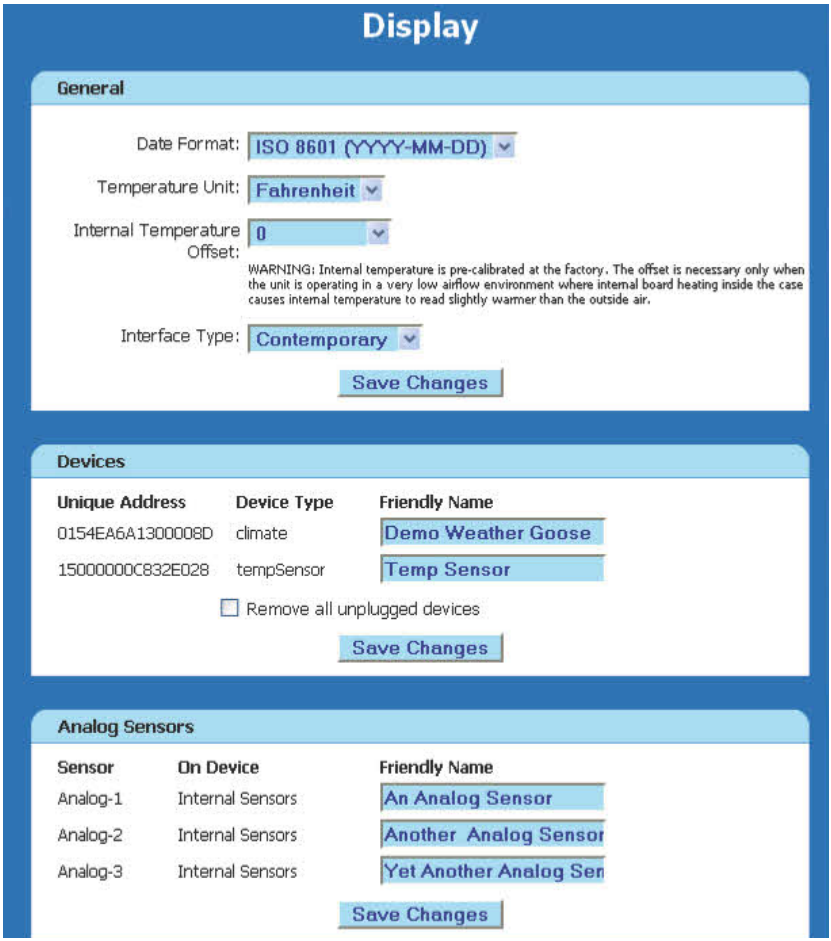
Data from the log can be graphed on this page as well. The user can select which data items to graph, as well as the time scale of the graph. The time scale can be from the last 15 minutes to the last 30 days. Note that the graph is drawn from the log, so a sensor's readings have to be in the log in order to be graphed. If logging has been turned off for a particular sensor, then data from that sensor cannot be shown in the graph. On the other hand, turning the graphing_____ off for a particular sensor does not affect the data in the log. Data will continue to be accumulated (as long as logging for that sensor is turned on, of course!), and will remain in the log until it is either pushed out by new data or "Reset Logs" is selected, regardless of whether you choose to view it on the log or not.

Display Options

This page controls how the other pages look. Various date formats can be selected, and temperatures displayed in Fahrenheit or Celsius. The default language can be set as well.

There are several different page layouts available. The one shown here is “Contemporary”, but the user can also select a “Classic” design that looks like the pages from the WeatherGoose-I family – a feature that users of our older products may appreciate! – or a minimal-graphics design that will download faster, and use less bandwidth, for users with slow or data-limited connections.

This page allows the user to set “friendly names” for the Goose and for each sensor, i.e. names that help identify each sensor as something more descriptive than just “Temperature” or “Light Level”.



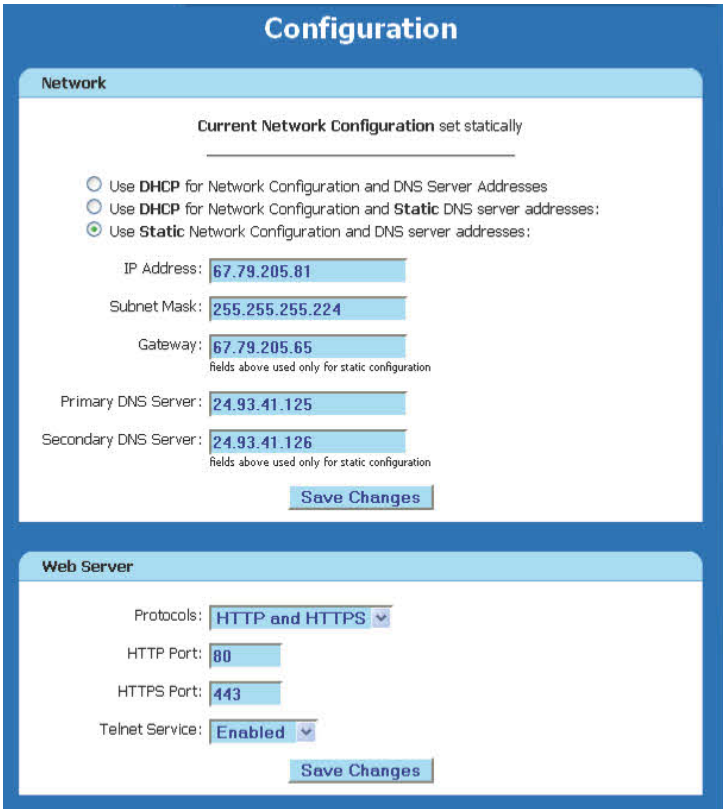
Config Page

The Config Page breaks up into five subpages. Each of these pages covers a different part of the WeatherGoose-II configuration. It is recommended that a userid and password for the administrator account be set. That way, only someone logged in as admin can modify critical settings.

As will be shown later, there are potentially three levels of access: Admin,

Configuring Network Parameters

The Goose's network parameters can be set manually, or from a DHCP server. In the example below the addresses are set manually. At a minimum the IP address, Subnet Mask and Gateway address must be specified. At least one DNS server must be specified so that the user can enter URLs instead of IP addresses for external machines.

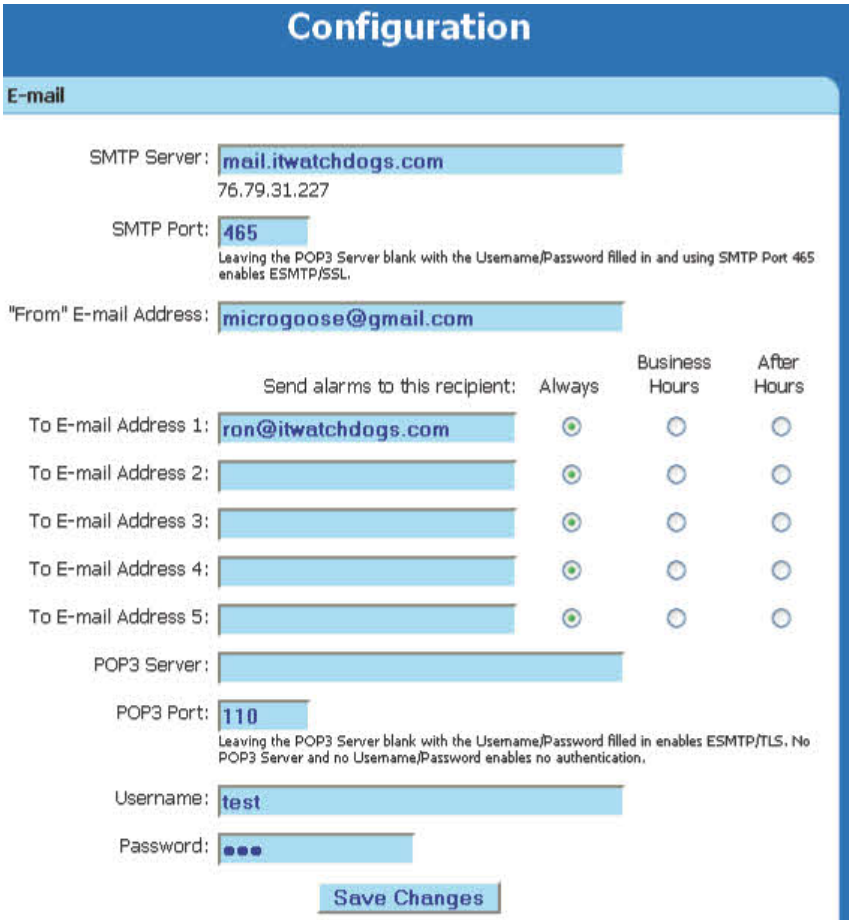


The user has the option to allow connections to the Goose using the standard HTML access, secure HTTPS access, or both. The unit defaults to the standard ports of 80 and 443 for HTTP and HTTPS, respectively, but these can be changed if your intended application requires non-standard port assignments. The Telnet service, which provides access to a powerful command line interface to configure a variety of options on the device, can also be enabled or disabled from here.

Note that the "Save Changes" button must be clicked, or any changes will not take effect.

Monitoring Configuration

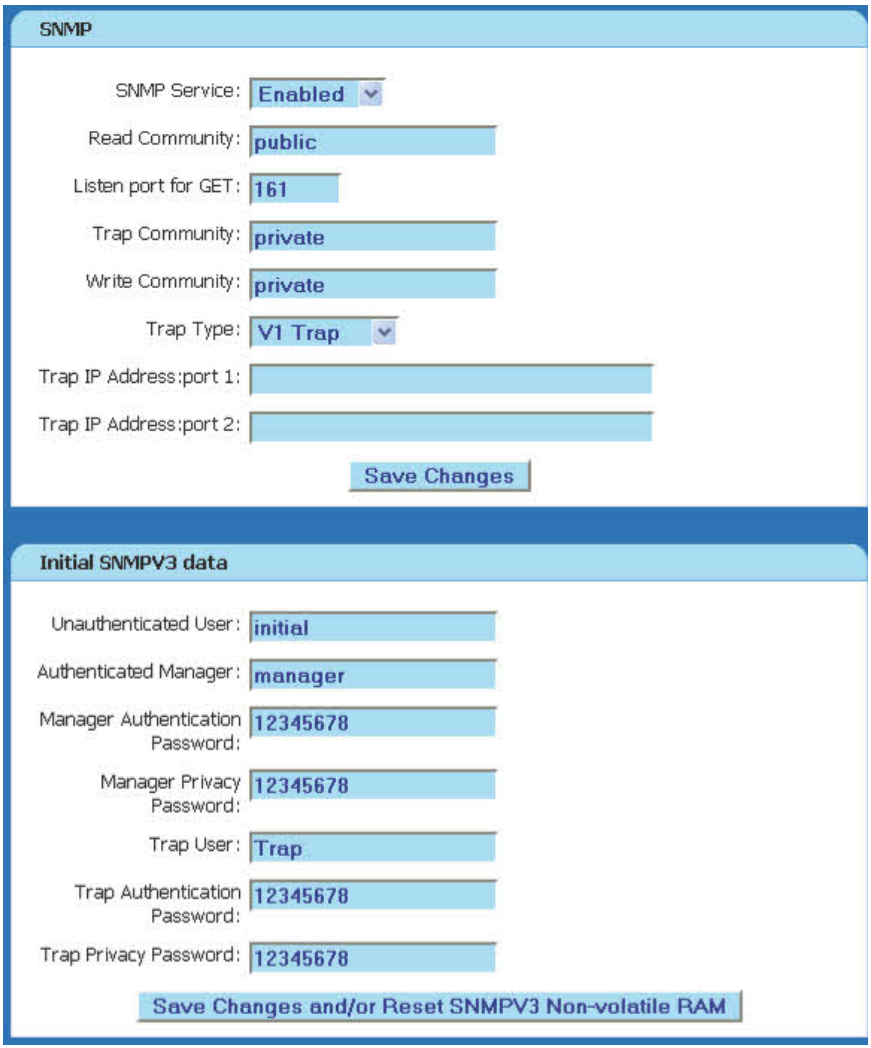
As described previously, the Goose can send an email to up to five email addresses when an alarm is tripped. The user has to designate a mail server and set the Goose up to talk to it. Each address can be set to receive emails only during business hours, after hours, or always. The days of the week and the hours included in "business hours" can be defined as well.



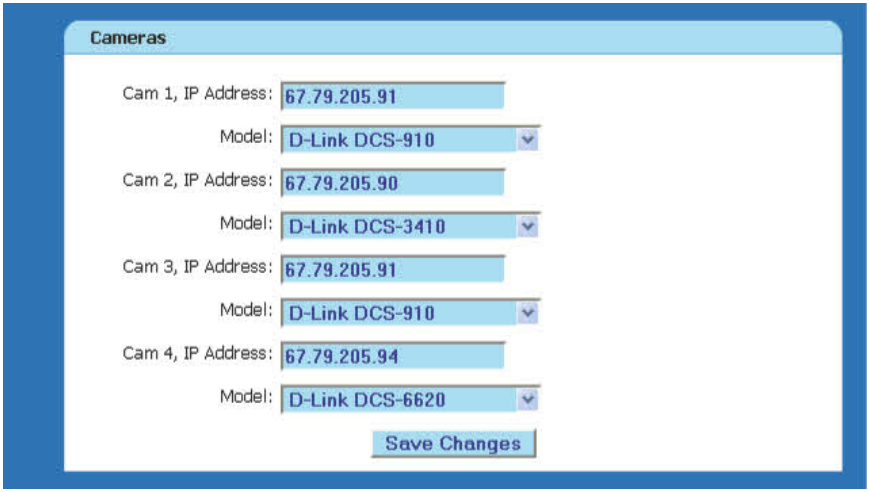
System status reports can be emailed to each address at specified intervals or at a specified time on a specified day of the week. Three different time schedules can be set up. Each report can go to any or all of the five email addresses.

Further down the Monitoring sub-page, the Goose may be set to send a status email to any or all of the specified email addresses. A message can be sent from every hour up to every 4 hours, or on a specific day of the week.

All the Geese include an SNMP ("Simple Network Management Protocol") agent. The WeatherGoose family supports SNMP v1, v2c, and v3. v1 is the standard SNMP, v2c is an improved version, and SNMP v3 adds security features such as authentication and encryption. The trap addresses here are the addresses that SNMP traps can be sent to when an alarm trips.



The Geese can display images from Internet enabled cameras on the "Sensors" or landing page. The Geese do not actually handle the image data from the cameras; rather, they provide a link in the HTML code sent to the user's browser that causes the browser to download the images and include them on the web page. This link includes the IP address of the camera and the URL of the image itself. To use a camera that is not on our drop-down list, the user must specify the URL that the camera uses for its snapshot image in addition to the IP address of the camera.

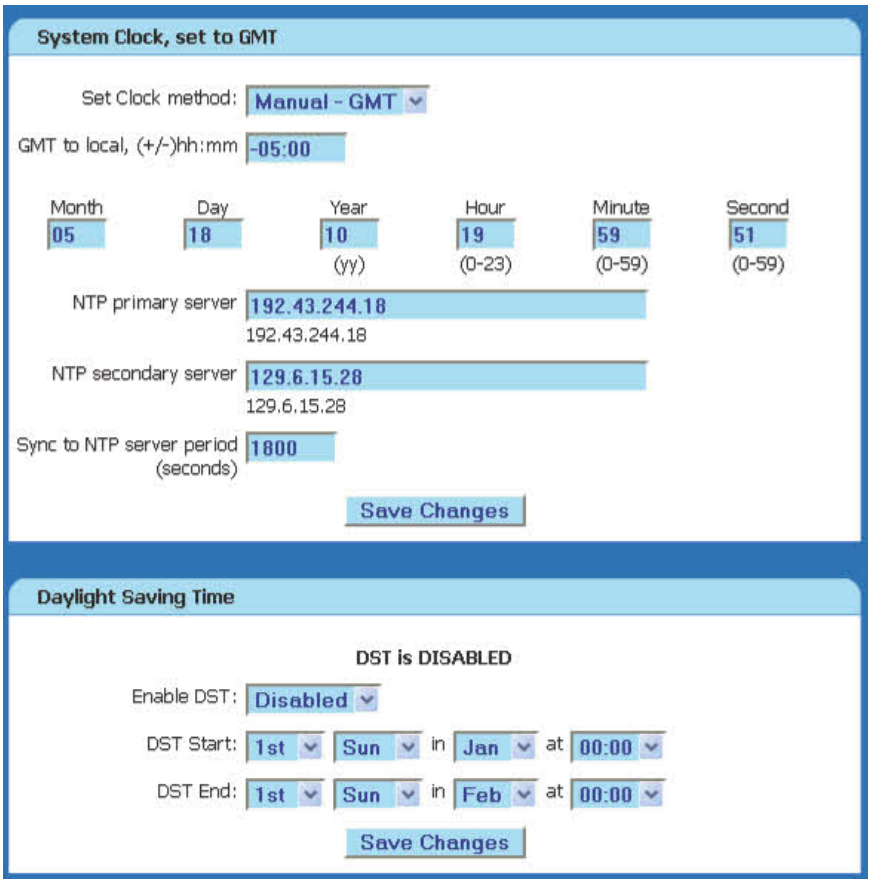


NOTE: The Geese cannot connect to the type of webcam that connects to a PC using a USB interface. The camera must have its own web server built into it.

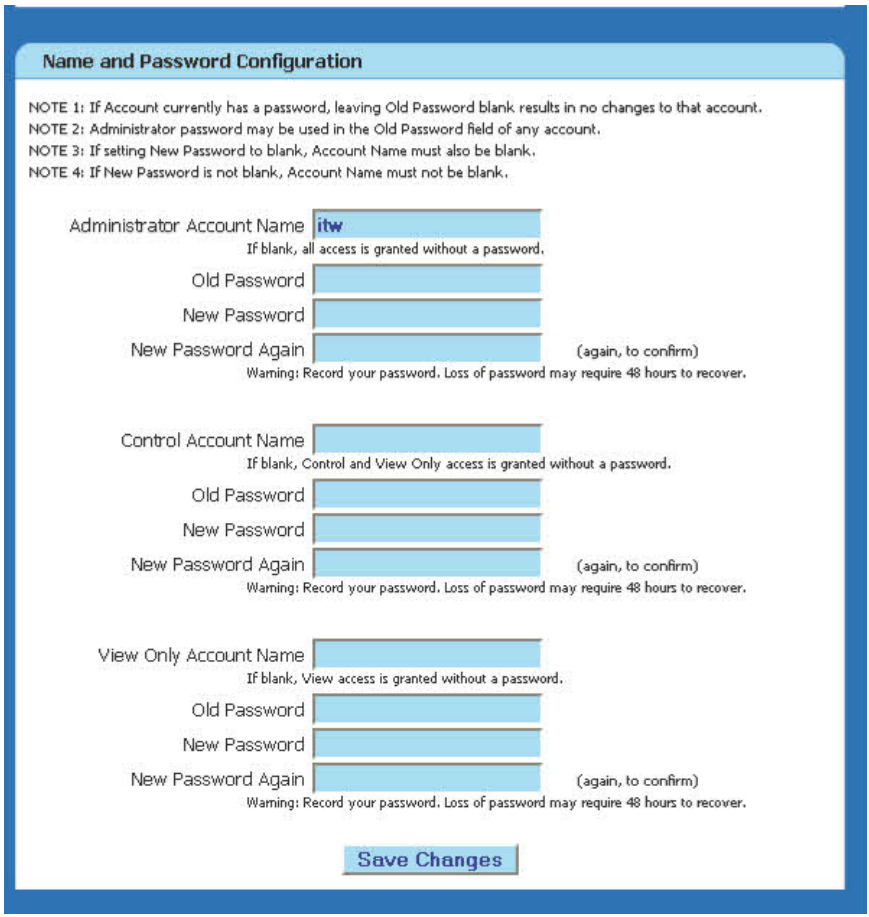
NOTE: The camera's IP address has to be accessible from the user's computer, just as the Goose's address does. If the camera has a local address (such as 192.168.123.180) the images will only be visible on that local network.

Next, the date and time can be set manually, or the address of at least one NTP ("Network Time Protocol") server entered to get the time and date automatically. Note that if the unit's clock is not set (either manually or from NTP), no data will be logged, and "No data to graph" will be displayed where graphs would normally appear. The Goose can be configured to adjust automatically for daylight savings time if that is desired. (The user must manually configure the appropriate start and stop dates for DST for their local time zone.) If DST is Disabled then the Goose will not adjust for it. Note that NTP servers return GMT – if NTP is used the local offset from GMT must be entered. (Unless, of course, this Goose is installed in the UK.)

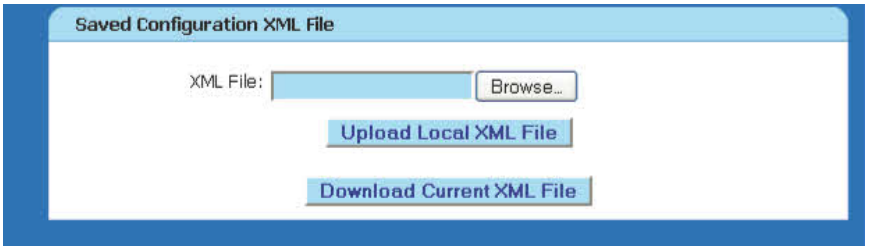
The climate monitors have a built-in real-time clock with a "supercap" backup, so the date and time are kept current for about two weeks if the power fails.



The Firmware allows for three levels of access to the Goose: Administrator, Control, and View Only. The Administrator has full privileges to change any parameter on the system. "Control" access permits the user to change anything except the parameters on the Config page, and the "View Only" account cannot change anything. ITWatchDogs recommends that you set at least an Administrator password: otherwise some unauthorized person could change something important, perhaps the network parameters. If those are changed the Goose can no longer be accessed over the network. The only way to recover would be to push the reset button described earlier, which of course requires physical access to the Goose.

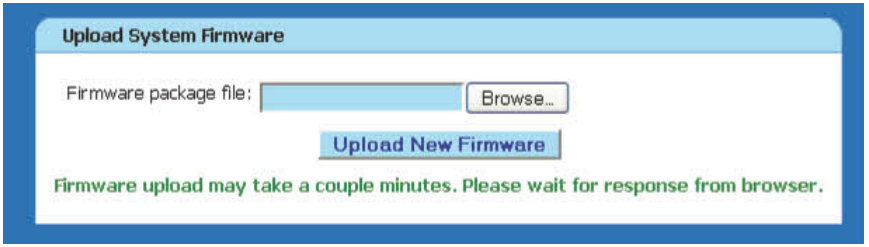


The “Saved Configuration XML File” allows a user to download the current configuration in XML (eXtensible Markup Language) format. This is a way to backup the current configuration settings by clicking the “Download Current XML File” button. The saved configuration can be sent back to the Goose by clicking the “Upload Local XML File” button. XML is a text-based format, so it is possible to edit the file before it is uploaded. This should only be attempted by someone who is familiar with XML, otherwise the upload may corrupt the Goose’s configuration.



The certificate and key file for the SSL (Secure Socket Layer) encryption must be set up to use the secure HTTPS communication method instead of, or in addition to the standard HTTP.

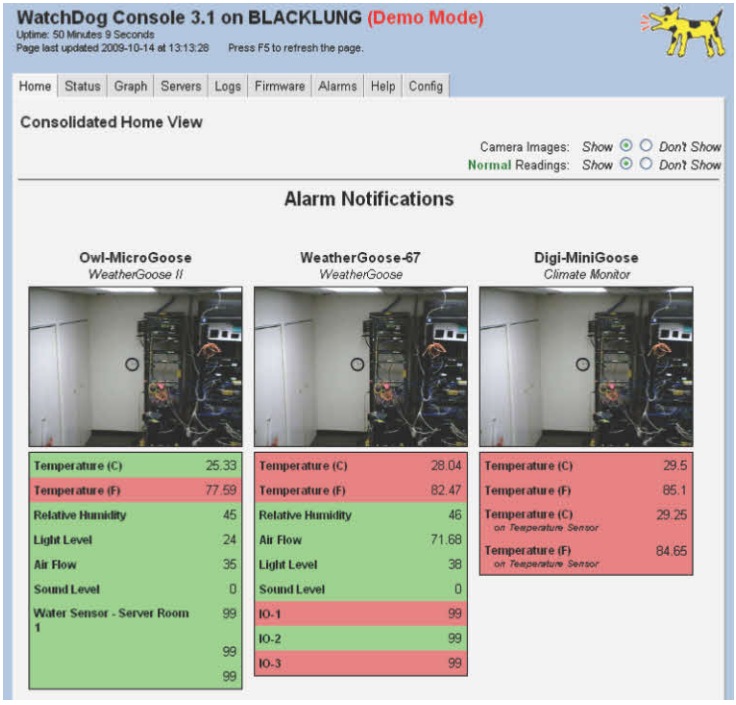
The developers at ITWatchDogs are constantly improving the firmware. New releases, including bug fixes and new features, are periodically posted to the web site (www.itwatchdogs.com). The "Upload System Firmware" button is how a new release is uploaded to a Goose. The WeatherGoose-II software includes this functionality that uploads new Firmware from the desktop to the Goose using the browser. Unlike our older series-I devices, there is no need to connect the Goose directly to a desktop PC and run a special update-installation program to upload new firmware into the Goose; everything can be done straight from the web browser, as easily as uploading a photo to your favorite blog or picture-hosting web site.



ITWatchDogs has developed and patented a method to insure that the entire file is uploaded correctly and completely before control is switched to the new software. That way, if the upload is interrupted in some way, or the file is garbled, the Goose will continue to run the existing software instead of crashing or locking up from trying to execute invalid or corrupted code.

Chapter 7

WatchDog Console



WatchDog Console

Some of ITWatchDogs' customers have just one or a few of our climate monitors. They can control their units by connecting to them one at a time. But many of our customers are responsible for monitoring tens or hundreds of units - it is not feasible for them to connect to each unit individually.

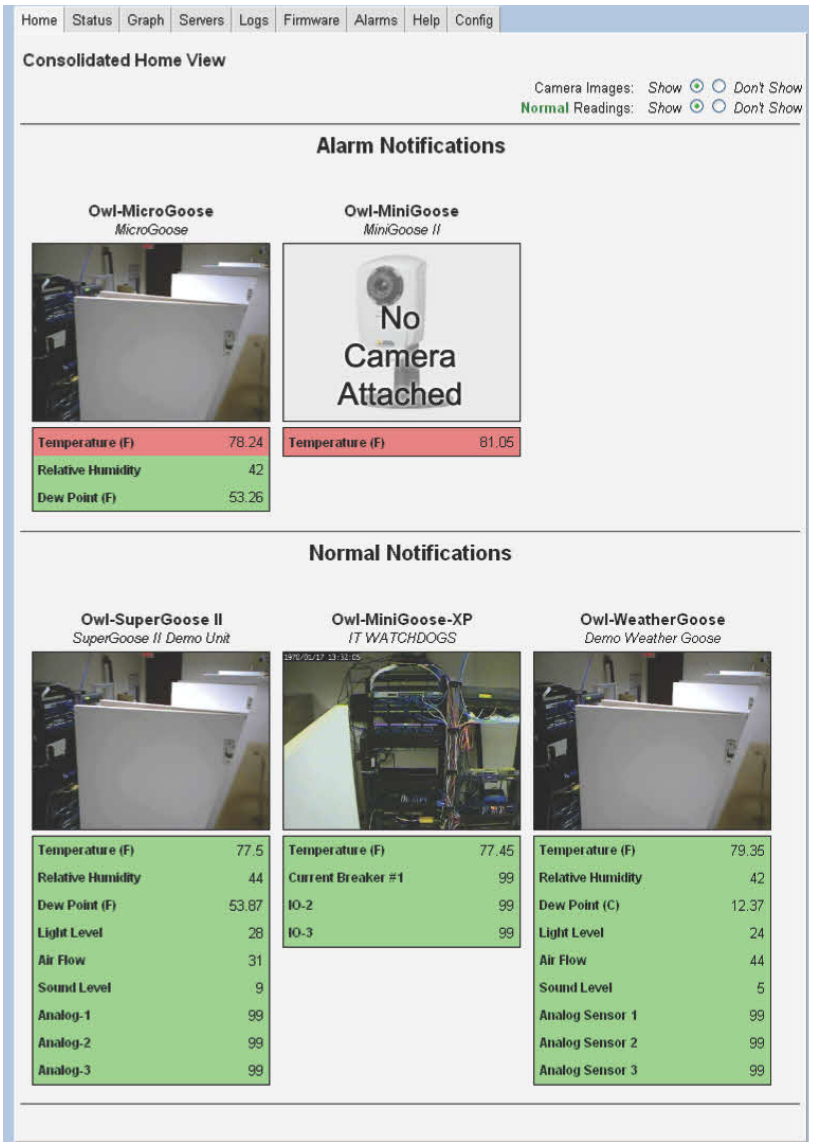
ITWatchDogs' "WatchDog Console" software provides a way to monitor multiple climate monitors using a single web interface. At this writing, up to 200 climate monitors can be controlled from a single web interface. WatchDog Console runs as a service under Windows Server 2003 and 2008, and Windows XP, Windows Vista and Windows 7. The WatchDog Console server can be accessed from a standard web browser.

WatchDog Console polls the units and collects sensor measurements from each one. The user can see an overview of conditions everywhere in the network. Similar sensors from multiple units can be presented on the same graph. The same alarm can be set on multiple units at one time. Firmware updates can be loaded to several units at one time. Thumbnail images from cameras connected to different units can be viewed on the same page.

The data is stored in an SQL database. It can be retrieved for offline analysis by any SQL-compatible tools.

Console Home Page

Below is an example Home Page from the WatchDog Console utility. In this case the program is monitoring five different climate monitors. Each one is shown with an image from an associated webcam along with the sensors readings from that unit. The user can elect to show all the sensor readings, or only those that have tripped alarms. The camera images can be shown or omitted.



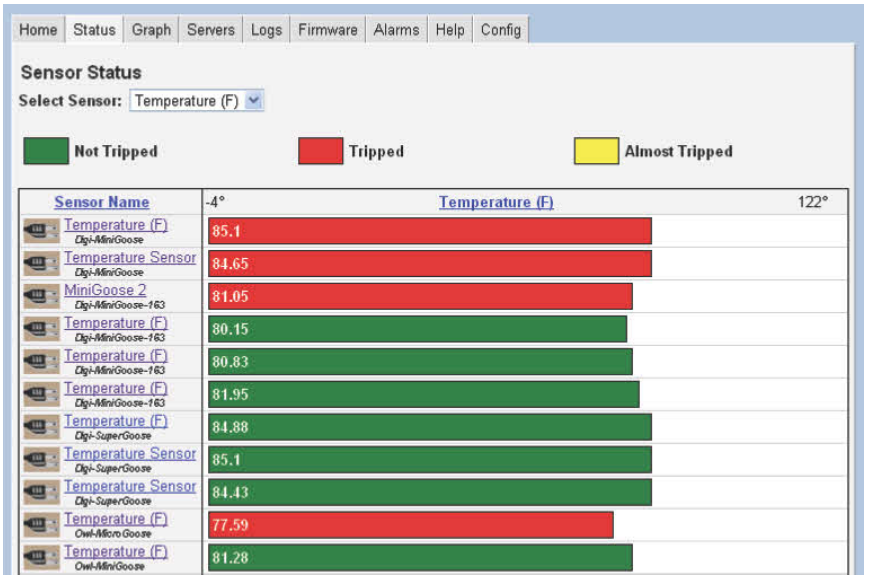
The monitors are grouped into three groups: monitors that have alarms that have tripped, monitors that have no alarms tripped, and monitors that could not be contacted during the last refresh cycle. The top two on the previous page have alarms that are currently tripped. None of the alarms on the bottom three units are tripped. If WatchDog Console failed to contact a climate monitor during the last refresh, that unit would be listed as being in an "error" status. This could be due to a network problem or some problem with the monitor itself.

Each climate monitor is labeled with its "Friendly" name ("*SuperGoose II Demo Unit*", "*ITWATCHDOGS*" etc) as well as its model ("*Owl-MicroGoose*", "*Owl-SuperGoose-II*" etc). The labels are hyper-links to the actual climate monitors, if you click on one you are taken to that unit's landing page.

The sensor readings from each device are shown with it. All the sensors from each device including external sensors are shown. The sensors are listed by the friendly names that were assigned to them when the climate monitors were configured. The sensors that have tripped an alarm are highlighted.

Status Page

A “Status” page shows real time data for a given sensor measurement. This way the user can look at all the temperature sensors, or all the airflow sensors, voltage, current, light level etc. Any measurement can be selected from a drop-down list at the top of the page. The list of possible measurements is determined automatically based on what units WatchDog Console knows about. An icon representing the sensor’s host device is shown along with user-defined “friendly” name that was given to the device that the sensor is attached to. Clicking on a device name will take the user to that device’s home page.

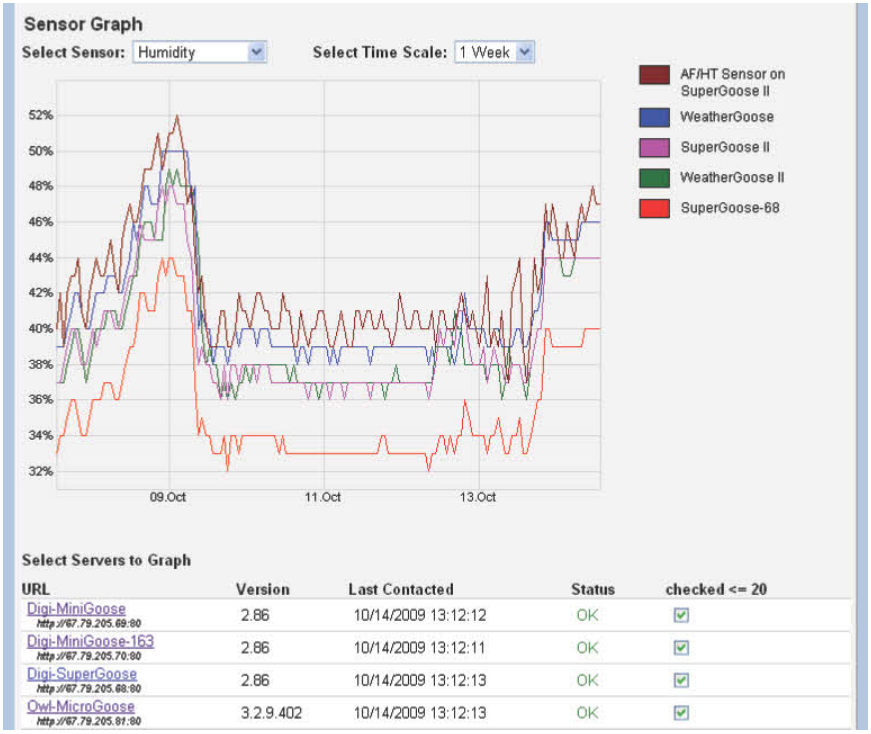


The sensors are color coded to highlight alarm conditions. Sensors that are unplugged are shown as “unavailable”.

The list can be sorted by sensor name or value by clicking on the corresponding header. Clicking twice on the same header changes the ordering from ascending to descending, or vice versa.

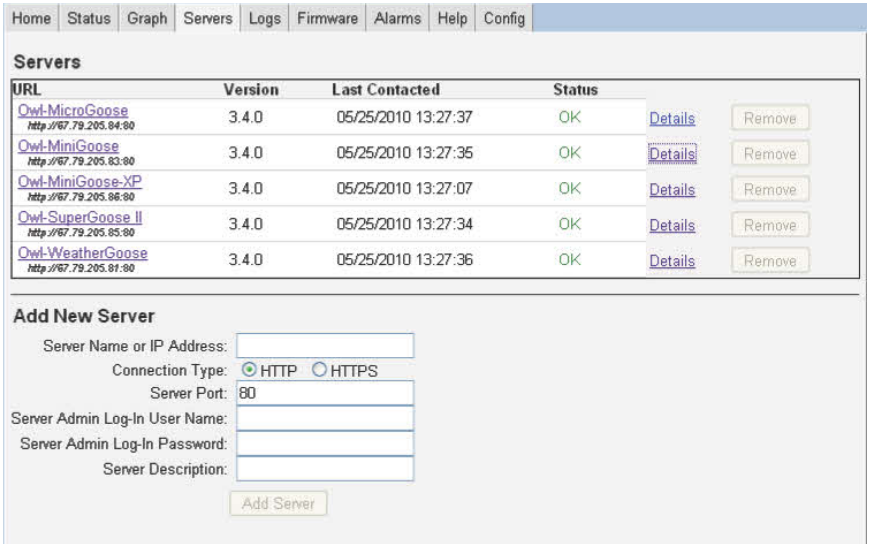
Graph Page

The “Graph” page displays a historical view of all the sensor data. The user can select any measurement from the drop-down at the top of the page. The log period can be set from 2, 4 or 8 hours or 2, 7, 14 or 28 days. Note that you can only select as many hours or days as there are logged data points in the current database. A list of all the connected climate monitors is shown below the graph. The user can select which ones are graphed at one time. A maximum of 20 servers can be graphed at one time.



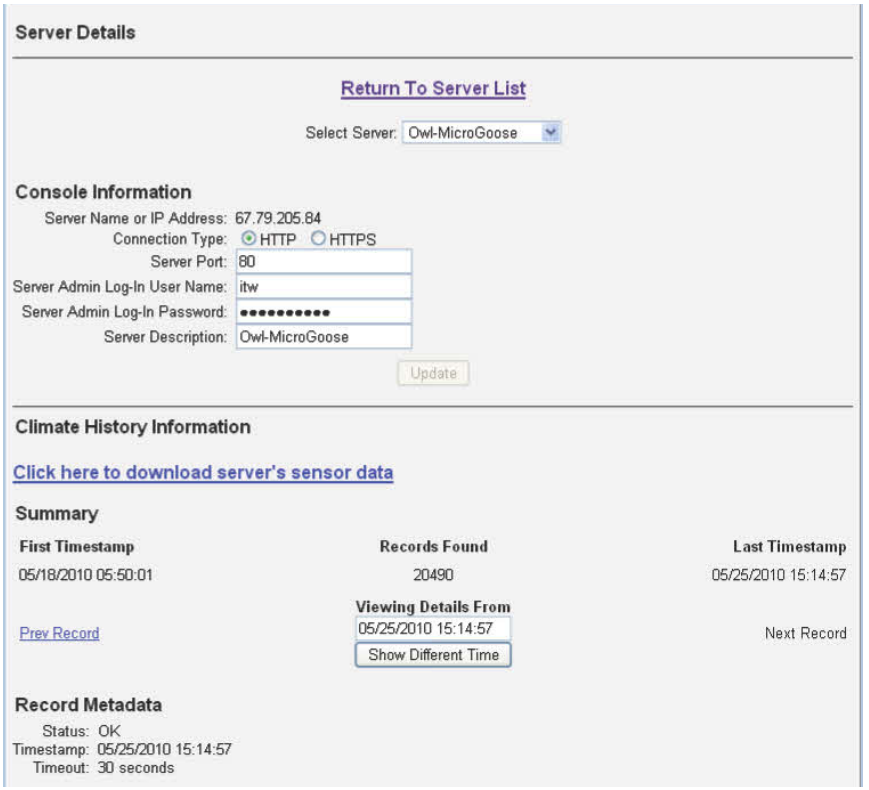
Servers Page

A climate monitor must be entered on the “Servers” page for WatchDog Console to monitor it. To add a server the user provides its name or IP address, a connection type, and the necessary passwords to access the unit. If the read-only password is supplied, WatchDog Console will be able to show a limited amount of information. The control account allows alarms to be set, and the admin password allows full control of the unit. A climate monitor does not have to be up to be added to this list, but its status will be shown as “Error” until WatchDog Console is able to contact it.



The URL, firmware version and last contacted time are shown for each server. If an error was encountered the last time WatchDog Console tried to contact a monitor, the status field will display an appropriate error message.

More detail on a given climate monitor can be shown by pushing the "Details" button after its name on the Servers page. The top of the page gives information about how WatchDog Console connects to it, including the admin log-in and password that WatchDog Console is using to access it. (If the server is in "error" status, it may be because this information is wrong and the climate monitor is rejecting the log-in attempt).



The climate history information is shown lower on the page. It is possible here to download all the logged data from the climate monitor in comma separated value ("CSV") format. Most popular spreadsheet tools can read this format, so they can be used to further analyze the data.

It is also possible to review the data in WatchDog Console's SQL database from this page. The first and last timestamps are listed. By default the data with the latest timestamp is shown (including the camera images). Data and images from any date time in the database can be accessed by entering the desired date and time in the "Show Different Time" field.

The sensor values and camera images from the selected date and time are shown at the bottom of the page. Again, the default is to show the record with the latest timestamp, but any record in the database can be accessed by entering the desired date and time. (If there is no record from that exact time, the closest time will be shown)

Server Attributes

Host:	MicroGoose
Address:	67.79.205.84
Address Backup:	
Name:	MicroGoose
Version:	CB_631
PVersion:	1.00
Mac Address:	00:34:67:78:90:51
Company:	I.T. Watchdogs, Inc.
Company URL:	http://www.itwatchdogs.com
Support Email:	support@itwatchdogs.com
Support Phone:	512.257.1462
Buzzer:	True
Temp Unit:	F

Cameras

Device 01FA5E73100000DD

Name	*Type*	*Available*	*Index*
MicroGoose	uGoos	True	0

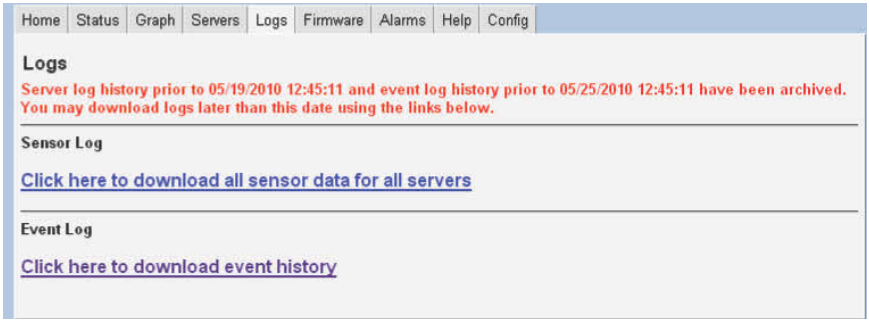
Sensors

Key	*Value*	*Name*	*Min*	*Max*	*Type*	*Trip Type*	*Trip Threshold*	*Notification*
TempF	78.27	Temperature (F)	-40	254.8	2	High	74	Email0,Email1,SNMPTrap0,SNMPTrap1
						Low	60	Email0,Email1,SNMPTrap1
						High	88	Email0,Email1
Humidity	40	Relative Humidity	0	99	2			
DewPtF	51.97	Dew Point (F)	-40	254.8	2			

Logs Page

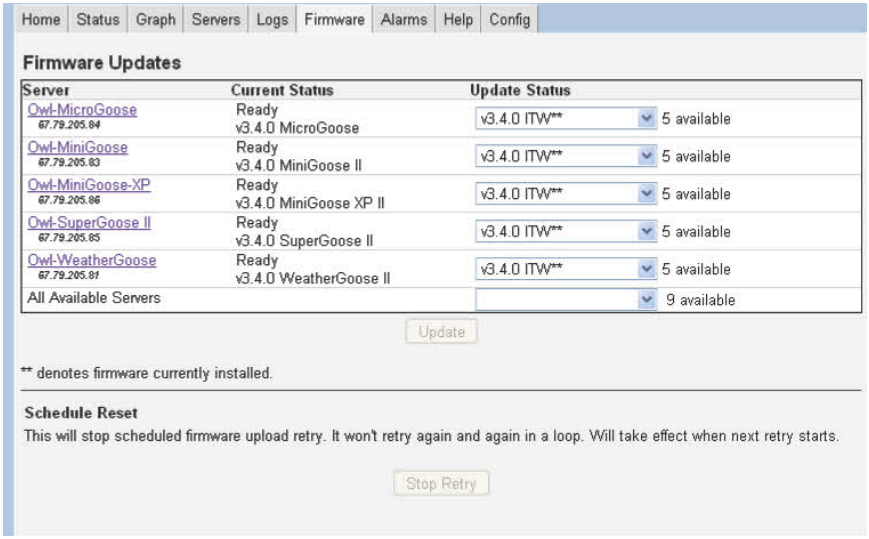
The “Logs” page allows the user to download all the available logs in a consolidated format.

WatchDog Console currently provides two data logs for downloading. One is a log of all sensor data for all servers currently in the database. The second is the event log, which contains information and errors pertaining to various WatchDog Console functions such as the web server, server refreshes, firmware updates and alarm updates.



Firmware Page

The “Firmware” page allows simultaneous updating of the climate monitors’ firmware. The page lists all the units that WatchDog console is monitoring. The current status column lists the firmware release that each unit is currently running. The drop-down menus on the right list all the available firmware versions that are applicable to this server. The user selects what version is to be downloaded to each server. Once the “Update” button is pushed WatchDog Console will queue the update requests, and push updated firmware to up to four units at a time. If a particular unit is already running the selected firmware version, nothing will be done; i.e., Console will not attempt to update the firmware with a version that’s already installed.

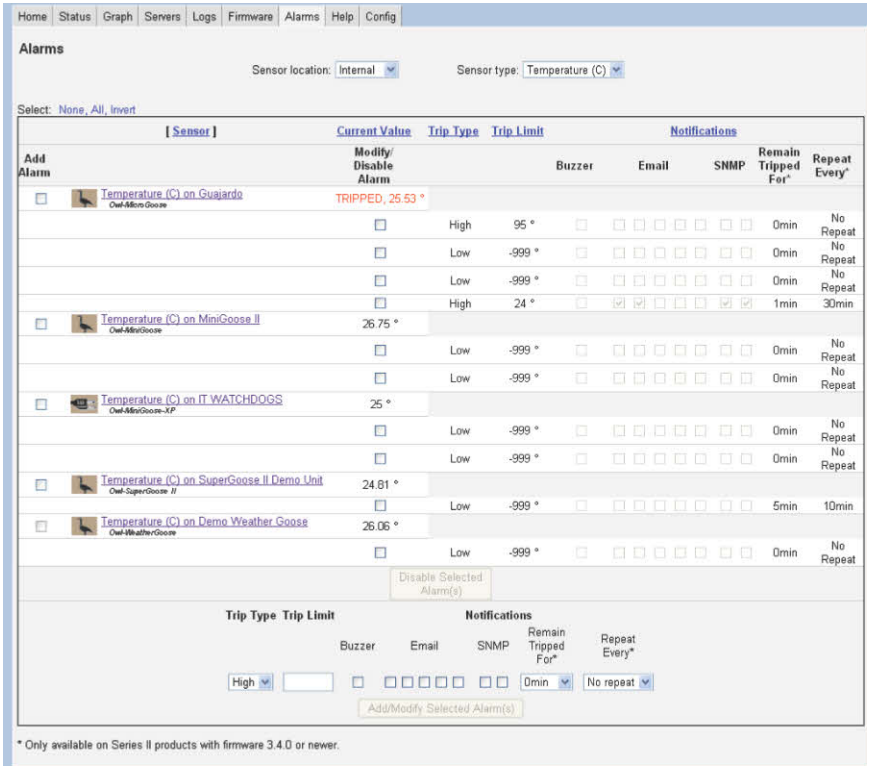


The last entry in the table is “All Available Servers”. If a version number is selected in this entry, then that version will be uploaded to all the servers that are in a “Ready” status.

If an attempted update fails, an error message will be displayed and WatchDog Console will retry it after ten or fifteen minutes. Remember that as of our series-II product line, ITWatchDogs’ Climate Monitors have a “fail safe” update process, so if an attempted update is interrupted or fails for any reason, the Climate Monitor will continue to run using its current firmware.

Alarms Page

The “Alarms” page allows the user to set an alarm configuration for sensors of the same measurement across multiple climate monitors. Any type of sensor that is connected to the units can be selected, and only internal sensors, only external sensors, or all sensors of that type can be displayed. Any alarm can be added or modified from this page. The user can select which email addresses should be notified, which SNMP traps should be sent, and how long the alarm should remain tripped and if it should be repeated or not. Selected alarms can be disabled also.



Configuration Page

The Configuration page allows the user to change many default settings. By default, WatchDog Console listens for HTTP connections on port 8090, and for HTTPS on port 443, but both of those can be changed if desired. “Only HTTP”, “only HTTPS”, or both connection types can be allowed.

The number of concurrent users can be limited (from 1 to 16 in WatchDog Console 3.1.3). A connection timeout can be set. Administrator, control and view only passwords can be set. A limit on the amount of time a user can be idle before he is automatically logged out can be set. Offset from GMT, default temperature units (°F or °C), and the number of concurrent firmware update sessions can be set.

The directory in which data is stored can be set or changed, as well as the log archive directory. The program can be tuned to trade memory usage for performance in case the server it is running on has a limited memory. The user can also enter usernames and passwords for the cameras that are being used if that is necessary.

Summary

WatchDog Console provides an easy to use way to monitor and control a large number of ITWatchDogs’ Climate Monitors. From it an operator can be alerted when an alarm is raised by any Monitor and he can easily zero in the problem. It allows alarms to be set on multiple units at the same time, and it provides a way to update the firmware on multiple units as well.

Chapter 8

Wrap Up

ITWatchDogs' climate monitors protect against all sorts of hazards that might be encountered in a server room. These include:

- Excessive heat
- Too high or too low humidity
- Airflow Problems
- Lights on when they shouldn't be, or off when they should be on
- Noise levels too high or too low
- Power failures or brownouts
- Low battery voltages
- –48 VDC supply malfunctions
- Equipment drawing too much or too little current
- Doors open when they shouldn't be
- Water where it shouldn't be

The climate monitors allow a manager to detect dangerous conditions and to be notified if they occur. The climate monitors display their sensor readings on web pages that can be accessed from anywhere on the Internet with an ordinary browser. They can send email alerts if readings go out of bounds, and they can also send SNMP traps to an SNMP Manager Application. The climate monitors include SNMP "agent" functionality so that the data-center manager can integrate them into his existing management process.

Monitoring Temperature

Heat is a crucial issue in data centers and many other places. Most members of the Goose family have internal temperature sensors that are accurate to within +/- 0.5°C. Most family members also have digital bus interfaces that allow up to sixteen external temperature sensors.

The internal sensor measures the temperature near the climate monitor. That's useful if the monitor is mounted in a rack with other servers, or installed in some other enclosure where the temperature needs to be monitored.

The external sensors allow a lot of flexibility in monitoring a room. One can be placed on top of a rack to measure the exhaust temperature. A sensor can be mounted in each of multiple racks to make sure all of them are cooling properly. Sensors can be put in different places around the room to find temperature variations and "hot spots" which need more cooling, or "cold spots" where cooling is being wasted. Another use is to put one sensor on the A/C return vent and another on the outlet. The difference between the two temperatures can provide a warning that a filter is clogged or that the A/C has a coolant leak.

ITWatchDogs' climate monitors log the readings from each temperature sensor so long term records can be kept and analyzed. They also can display the readings on graphs so developing trends can be spotted.

ITWatchDogs' monitors were originally designed for datacenters and server rooms, but our customers have found other uses for them as well. Several laboratories have used them to measure and log temperatures in experiments, and to warn the researchers if a temperature exceeds some limit. Some school lunchrooms uses them to log temperatures in a food storage cooler so the they can prove that the food has always been kept at the proper temperature.

The climate monitors have a way to set up an escalation procedure: one alarm can be set to trip on a given temperature and notify the first line support person. A second alarm can be set on the same sensor to trip at a higher temperature, and then notify a higher level support person(s). Up to five email addresses and two SNMP manager applications can be notified by a given alarm. Multiple alarms can be set on any sensor – the

only limit is that the total number of alarms set on all sensors cannot be more than 200.

Monitoring R/H and Dew Point

Many of ITWatchDogs' climate monitors have internal relative humidity/dew point sensors, and we also offer an external "combo" sensor wand which measures temperature, relative humidity, airflow, and (calculated) dewpoint all in one device. Relative humidity is displayed as a number from 0 to 100%.

Monitoring humidity is important for two reasons. Excessively high humidity, especially if accompanied by a drop in temperature, can cause water to condense inside electronic equipment and cause electrical shorts. On the other hand, if the humidity is too low, static-electricity charges can quickly build up on moving surfaces (or personnel!), causing high-voltage discharges which can disrupt or damage sensitive electronic equipment.

In either case, it is important that humidity be monitored and that someone notified when it is either too high or too low.

Dew point is related to relative humidity: Given the current relative humidity, the dew point is the temperature at which condensation will begin. If the relative humidity is high, the dew point is close to the current temperature. If the relative humidity is low, the dew point is much lower than the current temperature.

ITWatchDogs' monitors measure humidity and dew point, display their current values on a web page, and log and graph previous values. Alarms can be set to trip when either value exceeds thresholds that the user sets, and these alarms behave the same way alarms on any other sensor does.

Monitoring Airflow

Some of the climate monitors also have internal airflow sensors, and an external temperature/humidity/dew point/airflow sensor is available. Measuring airflow helps detect fans that are failing, or have failed. Multiple external airflow sensors will illustrate how the A/C vents are

distributing air across the room, and help you put the most air in the hottest spot.

Note: the airflow sensors sold by ITWatchDogs for use with our monitoring systems are not calibrated in CFM (cubic feet per minute) or any similar standard units; instead, the sensors simply report a number from 20 to 99, where 20 means very still air and 99 means very fast moving air. (A "true" CFM measurement is difficult to achieve without resorting to a mechanical measuring device – which would not only increase the cost and complexity of the sensor, but would add its own periodic-maintenance and long-term reliability issues to those of the fans you're trying to monitor!) Alarms can be set on the airflow sensors in the same way as for any other sensor attached to a climate monitor.

Monitoring Voltages

ITWatchDogs offers two voltage monitors, the City Power Monitor and the -48 VDC Monitor. The City Power Monitor is intended to monitor the voltage provided by the local power company. It monitors 100- to 240-volt AC power lines and provides a warning if the power fails. It is often used in situations where the gear is behind a UPS, but someone needs to be notified when a power failure leaves the UPS running on battery power. The power must be restored or the servers must shut down gracefully before the UPS batteries are drained.

The City Power Monitor is an analog sensor, which means it must be connected to one of the analog inputs on a climate monitor. If it is used with a monitor such as the MiniGoose which does not have analog inputs, or all the analog inputs are being used for other sensors, the City Power Monitor can be connected to a "CCAT" device, which converts the analog signal and can be plugged into a digital port.

The City Power Monitor output is one of two states, which correspond to "off" and on". If power fails and then is restored, the monitor output will stay in the "off" state for 30 seconds. This is to make sure than even a momentary failure is logged.

The -48 VDC monitor is intended to monitor 48-volt positive ground power systems typically found in telecom installations. It also connects to an analog port on the climate monitor or an appropriate CCAT device. From the voltage level displayed by the monitor the user can tell if a battery bank is discharged, charging, or overcharged.

Monitoring Current

Monitoring electrical current in a data center can be useful in at least two ways: making sure that a power line is not overloaded and the circuit breaker is not about to trip, and noticing that some device has failed and stopped drawing power. ITWatchDogs provides a clamp-on current transformer that measures AC current when connected to an analog input or the appropriate CCAT. It can be set to measure 30, 60 or 120-amp circuits.

Alarms can be set in the usual way on the current reading. The transformer works only on AC circuits, it will not work on DC. It must be clamped around just one of the conductors. If it is clamped around both conductors the magnetic fields will cancel each other out.

Monitoring Power

ITWatchDogs' PowerGoose II adds the ability to measure the power being drawn from a 10-outlet power strip on the back of its chassis. The unit reports the same environmental measurements as the WeatherGoose II, but also reports the voltage and peak voltage, current and peak current, the real and apparent power, and power factor from the power strip.

Monitoring Light and Sound Levels

Several members of the climate monitor family have internal light and sound sensors. These sensors measure the level of the light or sound, in terms of "light" or "dark" and "quiet" or "loud". Alarms can be set on the levels in the usual way.

One of ITWatchDogs' customers detected an intruder in their server room when he turned on the lights in the middle of the night. Another customer uses the light level sensor to log light and dark periods in a biology experiment.

Smoke Alarm, Door Sensor and Water Alarms

ITWatchDogs offers a smoke alarm that can be connected to an analog input on the climate monitors, or thought a CCAT to a digital port. Several alarms can be distributed in a room and daisy chained together, so an alarm will be raised if any one trips.

A door contact sensor is also available. It can be wired to alarm if a door is open when it shouldn't be, or closed when it should be open.

Water is a huge problem in a computer room or anywhere else where a lot of electronic equipment is located. Most commercial building are required to have sprinkler systems, and a bad sprinkler head can put a lot of water in a room in a hurry. The drip pan that collects condensed water from an air conditioner can cause a serious problem too. If the drain gets clogged up, the pan can fill up and start leaking. These pans are often found in the ceiling of a room, where a leak can do more damage. This can actually be a bigger problem that a sprinkler failure, because it happens quietly and it might be a long time before someone discovers it.

ITWatchDogs offers two water sensors. One is a point sensor that sits on the floor and trips a Goose alarm if it gets wet. The "water snake" is a more sophisticated device that detects water anywhere along the length of a detector cable (hence "snake") that can be up to 300 feet long. Water snakes are typically run around the room behind the racks to detect water before it is visible. Both the point sensor and the water snake attach to analog sensor inputs or to the appropriate CCAT.

Output Relays

In some situations it is useful for a climate monitor to do more than display an alarm on a web page or send an email alert. Some fire or burglar alarm systems can be triggered by an external contact closure. Indicator lamps or strobes that are triggered by an alarm can help a data center manager quickly identify which rack contains the bad unit.

The RelayGoose II includes three relays that can be energized when alarms are tripped. The relays have “Form C” contacts, which means the common, normally open and normally closed contacts are all brought to the front panel. That allows the switch to open when the relay is energized, or to close when it is energized, whichever makes sense for the application.

Conclusion

ITWatchDogs’ Climate Monitor family provides cost effective ways for a data center manager or a system administrator to make sure all is well in the equipment room. Various members of the family have different characteristics so that the purchaser can find one that precisely meets his or her needs.